Radio Controlled

Soaring Digest

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Front cover: James Mercado builds line tension prior to launching his Xplorer 4000. Photo taken at the 2012 World Soaring Masters, held at the AMA flying site in Muncie Indiana, by Mark Nankivil. Coverage of the event by Mike Reagan with more photos from Mark begins on page 63.
Canon EOS Rebel T3i, ISO 100, 1/250 sec., f13.0, 36.0 mm

Back cover: An Enjoy3 passes in front of the partial moon. Photo taken by Martin Pilney <http://www.pina.cz> at the F3J Samba Cup 2012. More of Martin's photos from this event can be seen starting on page 94.
Nikon D300, ISO 200, 1/1250 sec., f5.6, 200mm

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In the Air

Another huge issue of *RCSD*! 110 pages!

Marc Pujol continues from where he left off in the October issue ("F5J Altitude," p. 10) with a complete examination of his Genoma² airframe, from initial concept through its evolution to an extremely well behaved contest entry.

RCSD was contacted by OleRC.com earlier this year and given the opportunity to review the Toba F3B/F3F sailplane and the KST DS125MG servo. Fellow Seattle Area Soaring Society member Andy Page volunteered to review the Toba, while we handled the KST servo. Our sincere thanks to OleRC.com for providing the review samples and particularly to Mei who handled a number of concerns quickly and professionally.

Mark Nankivil was CD for the World Soaring Masters once again this year and he managed to forward nearly 2.5GB, more than 350 images, to *RCSD*. As you can imagine, going through this collection and choosing which to use was definitely a long-term project. MIke Reagan's write-up on the WSM event first appeared on the RCSE, and is reproduced here with his permission.

Martin Pilny usually photographs F3B events, but he did attend the F3J Samba Cup 2012 near the village of Sebranice, Czech Republic, where Samba Models (home of the Pike series) is located. His photographs are filled with color and superbly portay the "flavor" of the event.

And Stuart Bradley sent a few photos of his model storage unit, a reclaimed styrofoam box. We couldn't resist sharing it with *RCSD* readers.

Thanks again to **everyone** who contributed to this issue!

Time to build another sailplane!

F5J AIRCRAFT DESIGN

Initial concept and evolution of the Genoma²

Marc Pujol, marc.pujol1@free.fr

F5J discipline (also called ALES) appeared in January 2012. This is the first time for electric glider categories where the propulsion set is not so important. This is a revolution. This is the end for all such very expensive gliders full of carbon technologies that allow them to be very light and highly resistant.

So, for the first time, a standard glider can have “similar” chances against more optimized planes. Of course, similar doesn’t mean equal. There are still some differences between them. But strategies are of far more importance especially during a fly-off where the conditions are usually more demanding.

This paper is written to provide you with a rationale that may conduct you into the selection of your next F5J plane. Of course, you can apply it to any other discipline with a little adaptation.

At the end, I will provide you with the result of my own rationale and deliver a full glider definition set - a glider that appears to be optimum and far cheaper than any commercial design set, a glider you can build either with foam and composite materials, epoxy and bagging or with structural techniques as I did.

How to structure a rationale

The rationale has three steps:

- Regulation analysis and classification of points that appears important to win.
- Identification of the trigger elements of a plane and their classification in relation to the regulation and air conditions.
- Definition of the plane that meets such trigger classification.

Regulation analysis

The F5J regulation is quite simple:

4 meter maximum for the wing span, electric propulsion, 30 seconds to climb up to 200m altitude, and a penalty of 0.5 point per meter gained with the propulsion on.

You have to perform a ten minute flight that includes the altitude gain with the motor and a precision landing (1m <-> 10 points).

Figure 1: This is the ancestor (2008/2009) of the Genoma: The "Pamespumas," an F3B plane from my friend P. Medard (PAtrick + MEdard + PUjol + MArc= Pasmespumas) that I have transformed to experiment with yawing stability. This was a first revolution for me. But not the last one!

Of course there are additional requirements, but these are the majors.

First of all, what appears important is the advantage to cut the motor at low altitude. If you switch it off at 100m and all the other flyers at 200m, that is a 50 point difference if you made the same flight length. (If all the competitors are making 10.00 minute flights and 50 point landings, the first flyer gets 1000 points and the second 550 / 600 · 1000 = 917. That is 83 points less). In F3J, competitors are fighting for 5 to 10 points... Imagine what 83 points per flight is... F5J is the first time where the objective is not to be at the highest altitude possible, nor to do it in the shortest time possible. We then have to think differently. I will say "opposite." Instead of trying to launch high, we have to try to launch low. The plane must then have the ability to fly at low altitude, circling in the very small thermals you can encounter at such altitude.

Instead of being in a hurry, let's take time to go up and use the 30 seconds to reach the altitude and the location you think is good for thermaling. You can go 400m away (or even more) at the minimum altitude required to take the lift (for sure, you expect it is there). As a consequence, if you want to increase your chances, your plane must be quite big in order to be seen perfectly far away and must be very easy to fly.

For sure, F5J gliders must be different from any other disciplines.

This 30 second rule is the trigger rule of the discipline. It reinforces the strategy aspect and the pilot ability to successfully realize it.

Exit powerful motors, hello light weight propulsion set.

So let's be very open in our mind and choices.

This very first analysis reminds us that the flight has several phases and that each of them does not have the same influence on the final result. Determining which phase is important and which one is less or not important at all is a first mandatory step in the design of a new plane.

I have then split the F5J TD flight into five phases.

1. Altitude gain with propulsion
2. Thermal search
3. Altitude gain circling in thermal
4. Return to the landing field
5. Landing

In order to classify them, I propose to you the following method:

Compare each of them with the others and give 1, 2 or 3 points to the one that is more important. For example, Phase 2 (thermal searching) is much more important than Phase 1 (altitude gain with propulsion). It takes a 3 rating.

My personal rationale provides the tabular result shown in Table 1 at the top of the adjacent page.

Of course, your understandings may lead to different notations. And this makes the diversity of our world.

If we count points and crosses, that provides the results shown in Table 2 on the opposite page.

It is difficult to trigger "Thermal search" and "Altitude gain in lift." Both phases are quite equal. It is like chicken and egg. Which is first? It's up to you to choose. My rationale is that the 30 seconds to climb is also a time to go into the lift (or close to it). So "thermal search" might be less important than "altitude gain in lift."

Of course you do not have to sacrifice a landing for an additional few seconds of flight. But the place of this phase means that you must find a thermal, take the lift, and go back first. Landing is in addition.

Table 1: The author's personal rationale					
Is more important than	Altitude gain with motor	Thermal search	Altitude gain in lift	Return to landing field	Landing
Altitude gain with motor					
Thermal search	X (3)			X (1)	X (1)
Altitude gain in lift	X (3)	X (1)		X (1)	X (1)
Return to landing field	X (3)				X (1)
Landing	X (3)				

Table 2: Results of evaluation of the author's personal rationale		
Altitude gain in lift	4 crosses 6 points	Weight = 24
Thermal search	3 crosses 5 points	Weight = 15
Return to the landing field	2 crosses 4 points	Weight = 8
Landing	1 cross 3 points	Weight = 3
Altitude gain with motor	0 crosses 0 points	Weight = 0

So our plane must be able first to find and take a thermal. Second, it must have the ability to return home even far downwind, and then it must have the ability to land precisely.

Each phase requires a specific ability that corresponds to a specific plane parameter. So let's define the trigger elements of the plane.

Of course a flight occurs in a specific air condition. This must be defined first:

- Speed of wind
- Density of thermals in the field. Are they numerous, fare away from the landing zone, upwind, downwind…
- Thermal characteristics (force, size, catching altitude)
- Turbulence of the air
- Altitude of the field,
- Humidity,
- Ground and air temperature, sun
- …

In the design process, the plane will have to take into account all those elements.

<u>The plane and its trigger elements</u>

A plane is the result of alchemy. It is a complex balance between several parameters more or less independent, more or less against or in favors the others.

That's why it is important to have a clear view of their influences. (See Figure 2)

We will define the plane thanks to physical parameters and aerodynamic parameters.

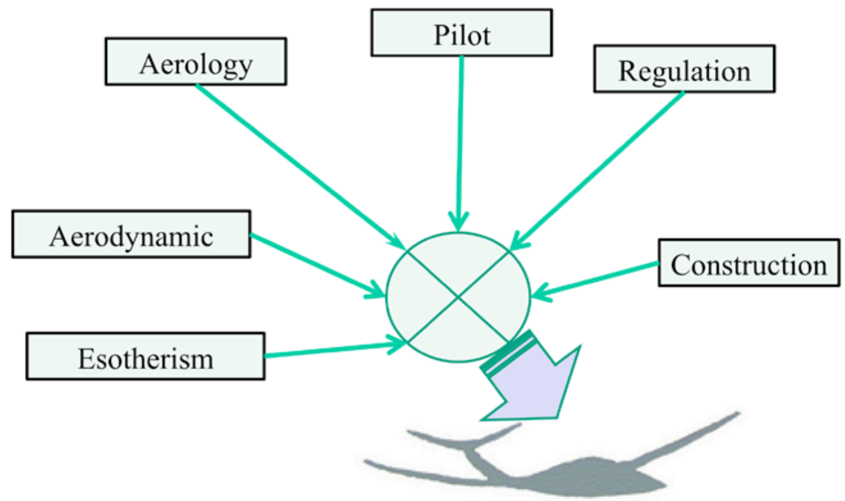


Figure 2: Plane creation: A complex alchemy.

Physical parameters are defined by:

- Span
- Chords and associated distribution
- Wing surface
- Aspect ratio
- Fuselage length
- Fuselage maximum front surface
- Tail surface (if any)
- Fin surface (if any)
- Rudder, flap, aileron, elevator sizes

- Weight of all elements and associated location in space and inertia
- Profile(s) data (Camber, thickness and position in chord of such…).
- Tail volume
- Center of gravity
- …

Aerodynamic characteristics are the consequences of such physical definitions on plane behavior:

- Gliding ratio and speed associated
- Minimum sinking rate and speed associated
- Speed polar (Vz/Vx)
- Yawing, rolling, pitching moment
- Yawing, rolling pitching dynamic behavior (frequencies and damping factors)
- …

Some of such parameters are real parameters, others are the consequence of a conjunction of them and should be rejected. We then need to have a clear picture and analyze everything.

So let's look at the physical parameters that allow the accurate aerodynamic characteristic behaviors that comply with our classification and air conditions.

In reality, we will do the reverse:

For each flight phase, we have to determine and optimize the aerodynamic characteristic that fulfills our classification and find the associated physical characteristics that comply with it.

<u>Altitude gain in lift</u>

In order to optimize altitude gain in a thermal, we must first study the thermals - their size, location, altitude...

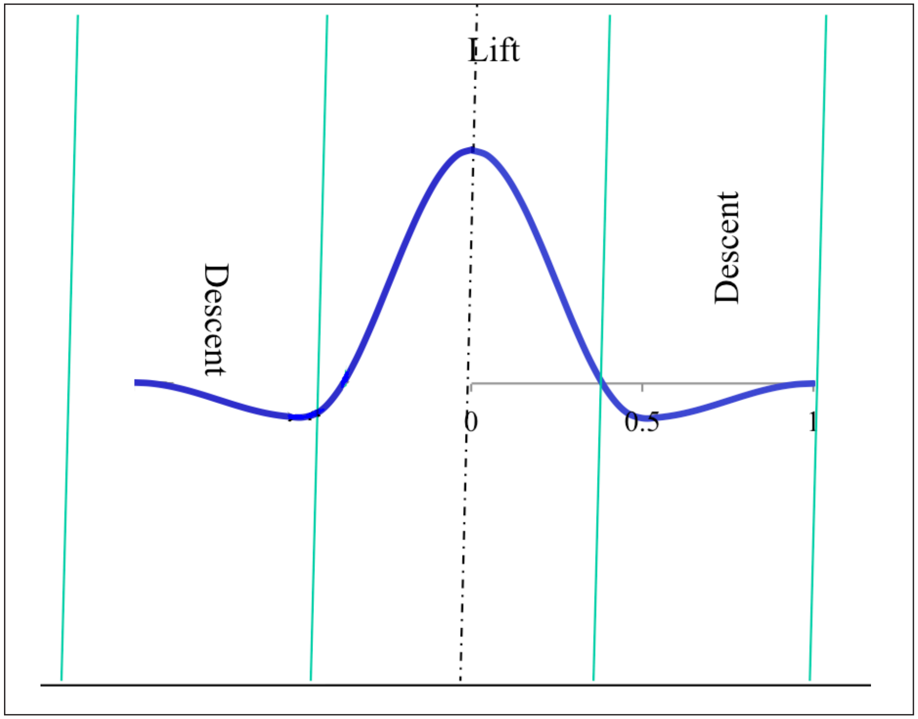


Figure 3: A thermal can be modeled with few sinus functions. Realistic? Let say this is not so stupid. That's a start of the understanding.

In Western Europe, most of the thermals are quite narrow at low altitude. Let's say that typically, the lifting air has a diameter of 20m at 50m altitude. This will then be a reference for our plane design.

Their location and density in the field depends upon the field itself - humidity, temperature difference, sun… Nothing to say for the plane except that in some cases you might require going far away to find them (so big plane, easy to fly). (See Figure 3)

Knowing the thermals, then comes the strategy to circle and take the lift.

There are roughly three strategies:

(1) Make a circle, estimate the center of the lift and make the next circle around the estimated center…

(2) Increase circling radius when the lift appears slow, relax the circling radius when the lift increases in intensity.

(3) Cross the lift, make a quarter turn around the lift, cross it again, estimate the lift in size and center and then circle.

Studies have been made for drones in order to optimize their flight duration. Different software has been tested to find the better strategy. To this end, this depends upon the turbulence rate. Strategy (1) may be a bit easier in turbulent air.

But what about our planes? Nothing and lots of things.

First of all, you need to circle and then have the ability to continue circling. But how tight?

Knowing the size of the thermals and their intensities, we can compute the sinking rate of a plane circling and then predict if the plane is going up or down. This allows predicting the best bank angle to take the lift. This shows us that it

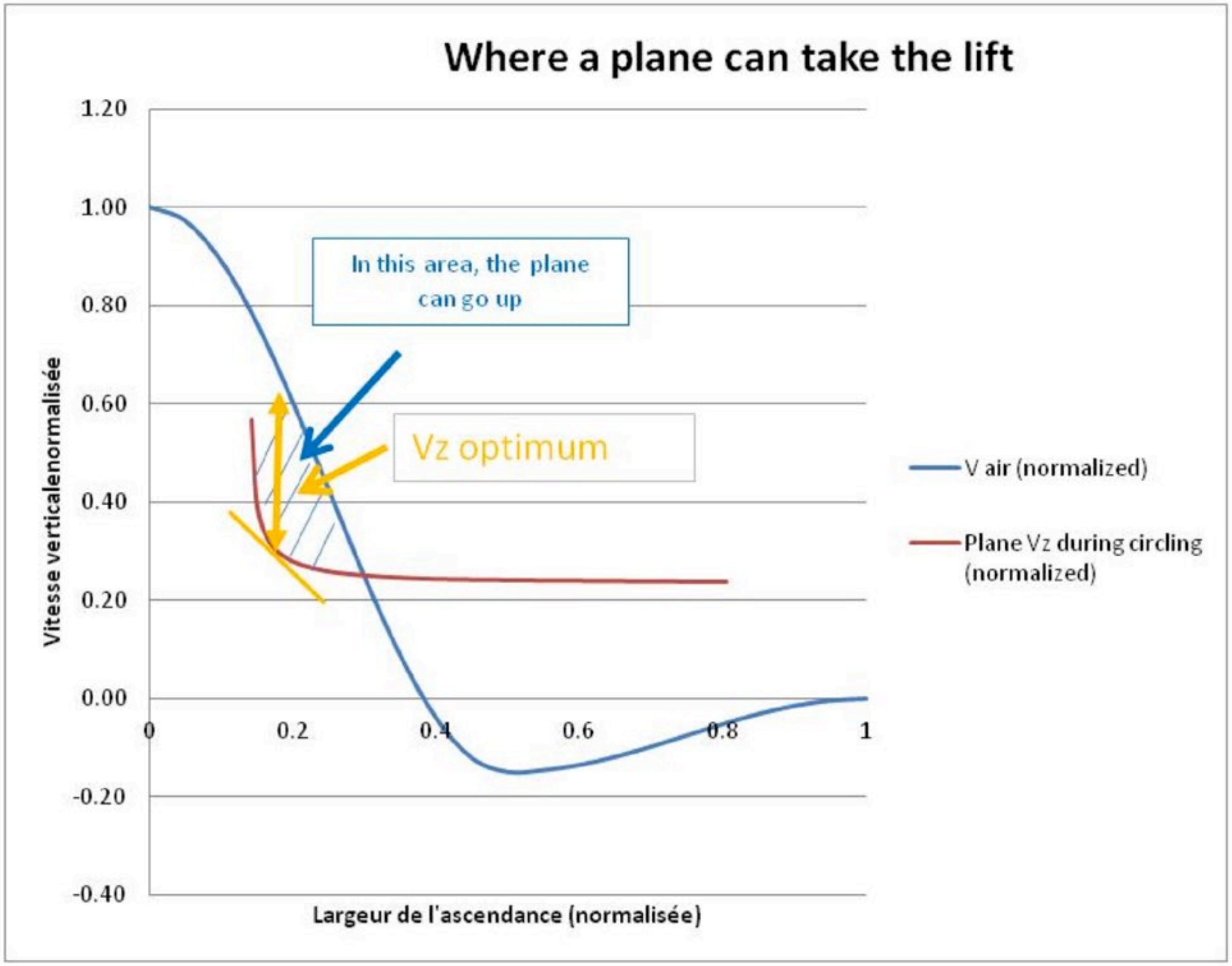


Figure 4: The model of a lift is useful to estimate the optimum circling radius. For small lift, the bank is more or less at 45°. Quite tight isn't it?

is required to circle at high angle (more or less 45° in our reference case). Our plane must then have the ability to circle with a small radius in a very easy way. (See Figure 4)

Of course, in order to take low intensity thermals, the sinking rate of the plane must be minimum (advantage to big planes and light planes).

Circling ability and minimum sinking rate, that's two important aspects.

The circling ability is, at first, a matter of:

- Wing loading. It must be as reduced as possible
- Cz. It must be as high as possible
- Cz^3/CX^2. This demands high lift and low drag. Some thin airfoils would potentially be required then.

Despite what is usually believed, circling ability is not a matter of wing span.

Make few calculations and you will see that if you can reduce the circling radius by a few percent, the climbing rate is increased much more. Circling ability is then the very important characteristic of the F5J category.

To finally convince you, we had two competitions this year where the first or the second place was taken by a motorized F3K plane or an Easy Glider.

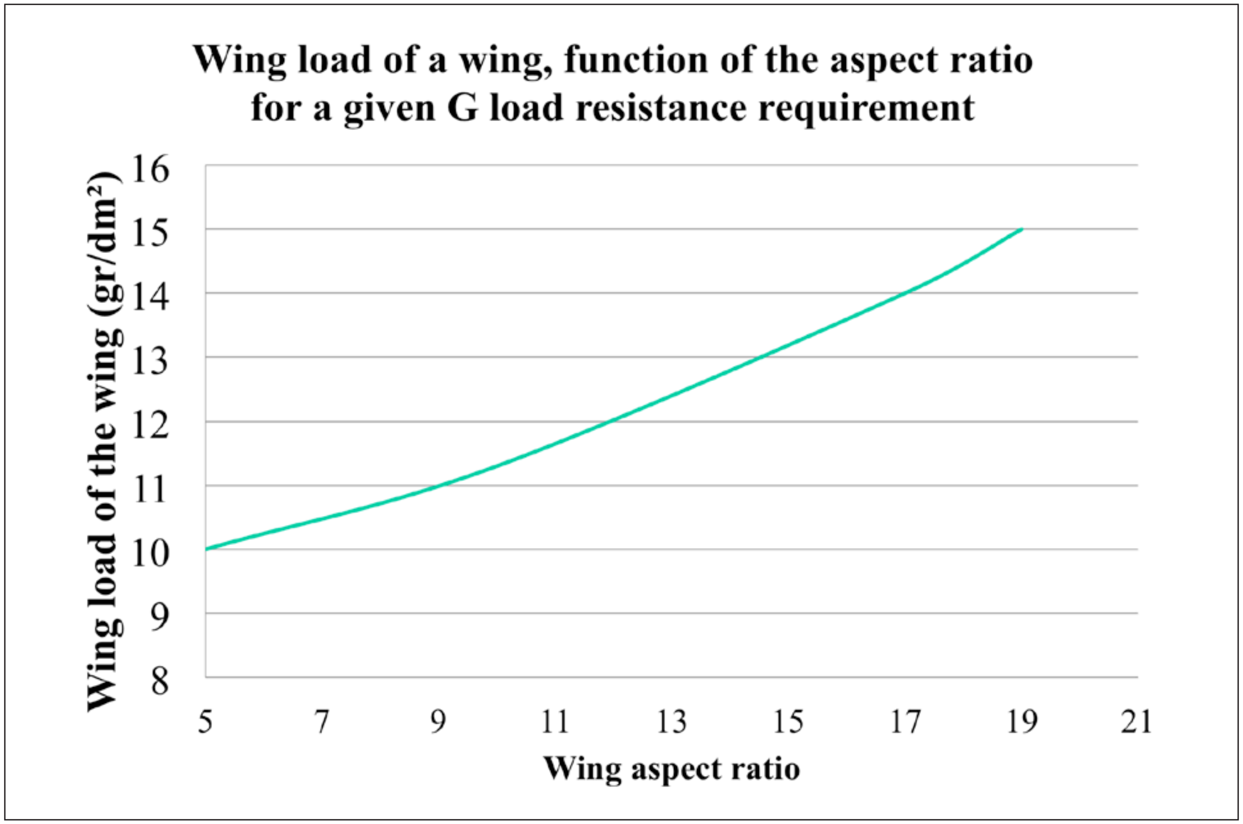


Figure 5: The higher the aspect ratio, the higher the wing loading. It's not for nothing that birds like eagles have quite low aspect ratio. And it is also not for nothing that sea gulls have a higher one. They do not fly the same air.

They where competing against full carbon 4m planes with good pilots... What were the differences between them: Ability in circling tight! This is also confirmed byfull size glider experiences where for example, a Pioneer (full metal very rustic plane, but very agile thanks to a long fuselage and which flies at low speed) was compared to a Bocian (SZD plane with a 30% better gliding ratio and speed). The first one was said as having better thermal ability without doubt.

Of course, we need to fly in the wind. We then can define a wing loading range that will have to be obtained to cover that complete wind condition range. Let's say that standard wing loading (for the complete plane) should be between 20 and 30 g/dm².

Since there is a direct link between aspect ratio and wing weight, the aspect ratio should be as high as possible to obtain the minimum wing load (i.e. the 20 g/dm²). It is then a matter of construction techniques and propulsion equipment weight and no more a matter of aerodynamics. (See Figure 5)

If you have studied thermals, you must know that at low altitude they are quite small. Circling may then be most of the time at high angle of bank. This can be

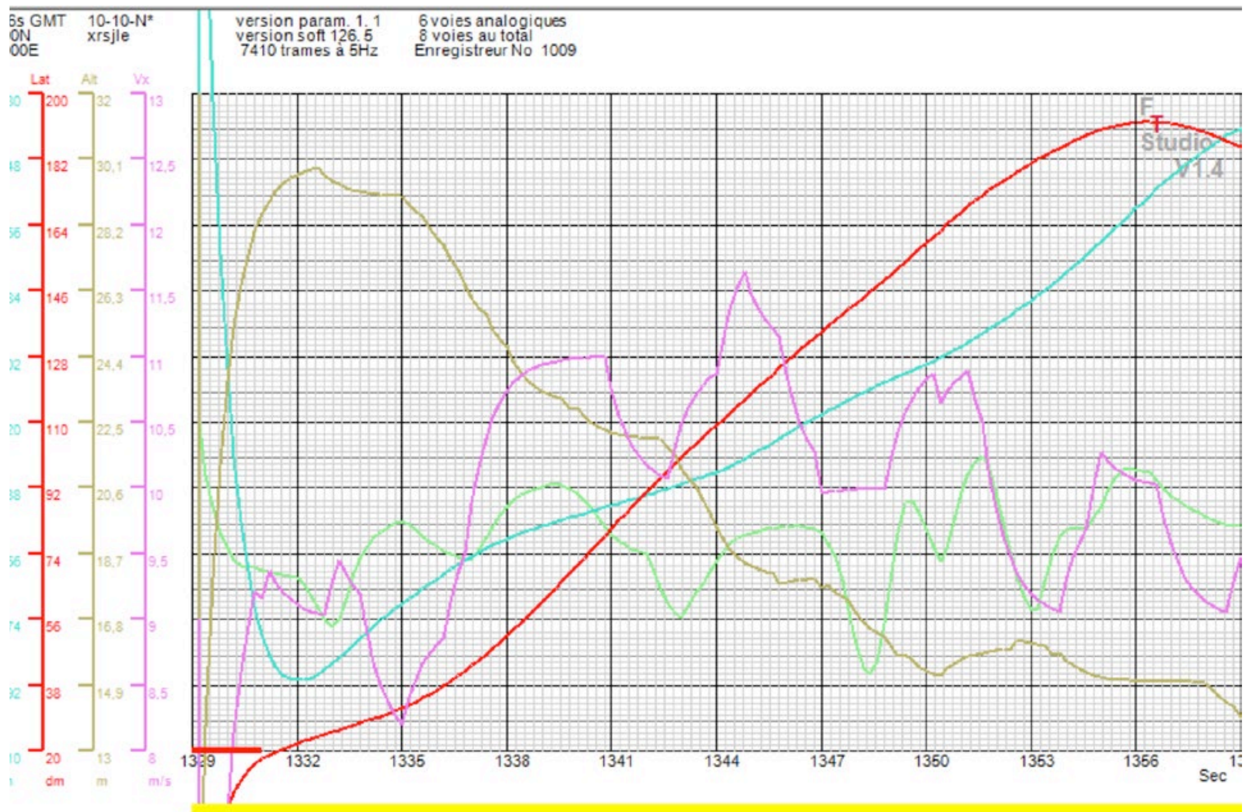


Figure 6: Blue and red curves are longitude and latitude. The plane is going straight. Light brown shows the altitude, the pink one is the speed and the green one is the yawing. As you see, even if the pilot tries to flight straight, the reality is a bit different. It is the conjunction of Dutch roll and phungoïde movement. All such movement (minimum V +/- 1m/s and yawing +/- 3 degrees) are very difficult to be seen without measurement devices.

feasible if, and only if, the yawing stability is optimum. In order to illustrate this, I will say that the plane must fly like an F3K one. As a consequence, the fuselage should be accurately long and the fin surface also accurately calculated. Here, it is a matter of dynamic behavior and no more a static one. Refer to *RCSD* late 2011 for a better understanding.

I can say, without much pretention, that actual F3J planes are not optimum in that concern (except for the SUPRA in its original configuration (1.4kg)). The fuselage should be longer and fin surface increased.

Once again, it is not sufficient to have a very good wing to make a good plane. If the plane doesn't have accurate dynamic behavior, the wing can not express its best. And the pilot can not place the plane in a very easy manner at the right time in the right position at the right speed. (See Figure 6)

Tight circling and long fuselage have consequences on fin flap size: When turning, the radius describes by the wing is not the same than the one on the fin. This means that the natural effect of a fin during circling is to go against the turn. In order to have a turn without skid, it is required to have the fin in the direction of the turn. And the longer the fuselage is, the more important the action on the fin is. Of course, in reality, due to bank angle, the action is on both fin and tail. But the rationale remains. (See Figure 7)

As a consequence, for a long fuselage, the rudder should represent 50% of the chord or even more. 60% should be preferred.

Circling requires also good low speed behavior. That means that the plane must have a speed range at low sink rate as large as possible. If you compare the Pike Perfect to the Supra, the Pike appears better in this area (and worse in others of course).

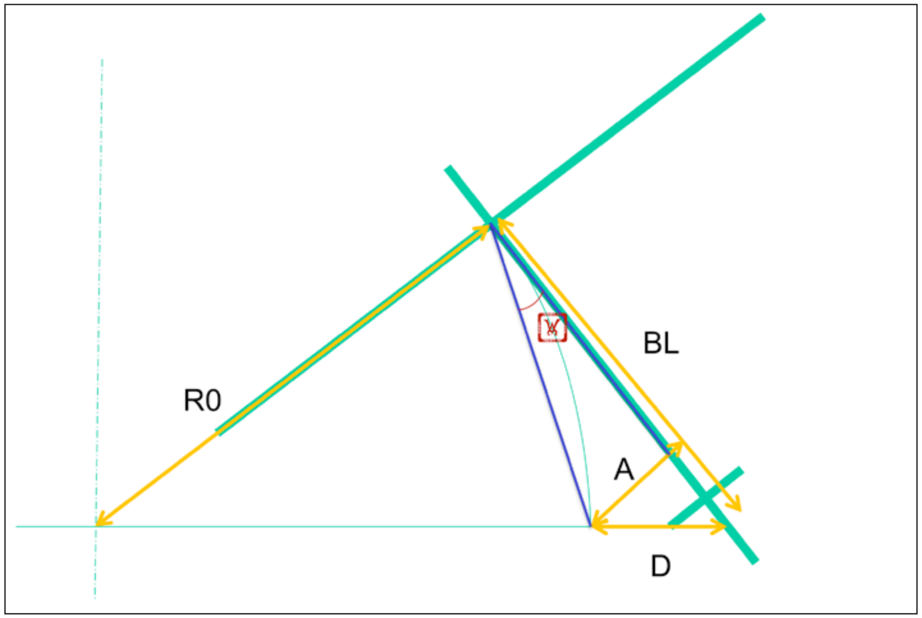


Figure 7: When turning, the tail describes a trajectory with a radius equal to "R0" but at a distance equal to "A + R0". For long fuselage "A" is not neglectable (up to 20 cm). As a consequence, the fin provides a torque in the opposite way of the turn. This requires fin action as if it was fully twisted from 5° to 13°. For sure, the flap should be quite important for a 4m span glider.

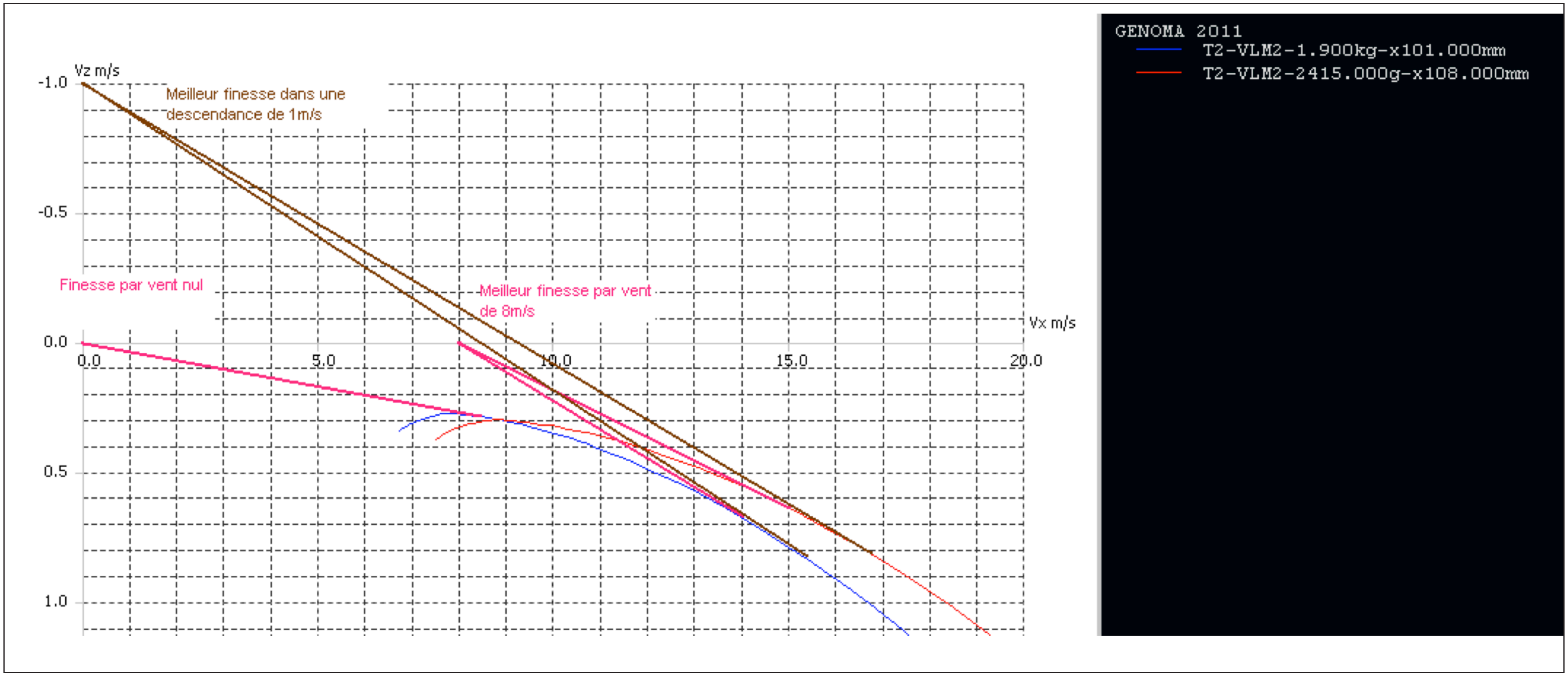


Figure 8: Trying to find the best speed that optimised up wind or downwind conditions, the McCready analysis shows us a range of speed between 6 to 15 m/s.

This is fundamental. I made speed measurements and it is very difficult to fly at a fixed speed even with the speed information in my eyes (I have a Xerivision system for my experiments). Even in a straight line, the plane's speed is varying from +/- 1m/s. This means that the minimum plane speed is much closer to the stall if the pilot expects to fly at Vzmin. If the plane speed range around Vzmin is not "very large," it is absolutely impossible to fly at Vzmin. The plane has a good chance of stalling, especially during circling.

And the more the flaps are deflected (in a positive way), the shorter this range is. So caution with flap during circling.

As a consequence, the F5J plane will have profiles with a bit more camber than for F3J. Flaps should be used for transition or speed reduction (circling in the core of the lift if stable).

Thermal searching

Despite the pilot ability to read the air and the ground, the plane must be able to reach the thermal prior to being too low in altitude.

This means best gliding ratio and good ability to signal air movement (so reduced inertia for the whole plane).

As the number of days without wind are quite reduced (especially in my living area), the plane must have the ability to have good gliding ratio between 7 to 15 m/s as it can be found playing with McCready approach taking into account sinking air and upwind flight.

So profiles and aspect ratio should be optimized for such a kind of speed range.

In F5J there is no requirement to have a plane that has good behavior at high speed. 100 km/h (28 m/s) or higher is only for fun. So keep it for F3J and other disciplines. (See Figure 8)

Of course, in order to have good ability in circling and good gliding ratio in the wind, flaps are required for high wind conditions.

The best possible gliding ratio is an alchemy that integrates profile drag at a defined lift, induced drag, Reynolds number, stability...

As a consequence, the profile thickness should be optimized according to its camber, (this means try to reduce it in the respect of critical Re), and aspect ratio maximized. Both should integrate the weight prediction for a defined load resistance.

For sure, the wing span is an important factor. 4 m span allows best gliding ratio. And since the wing span is limited, be sure that winglets will appear in the next generation of plane.

As written, it is alchemy…

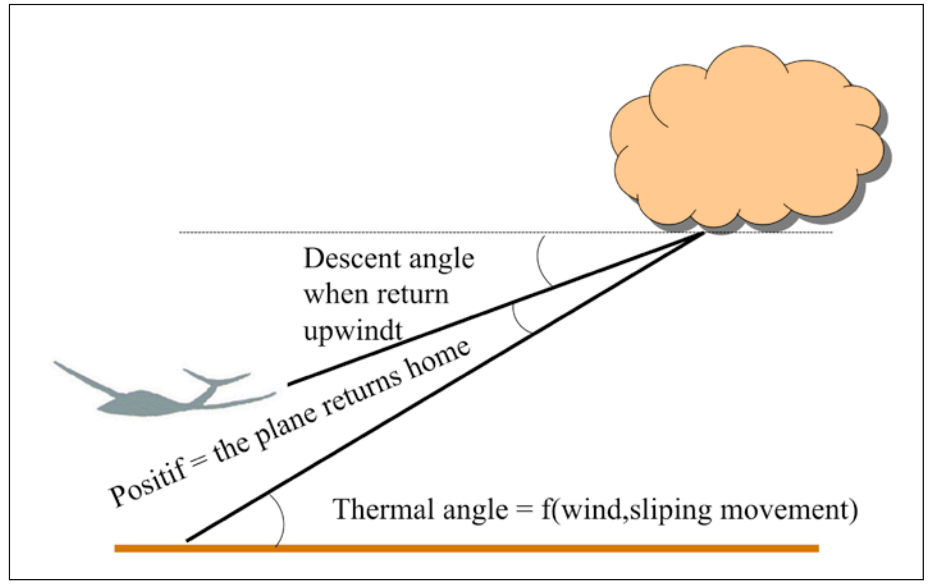


Figure 9: Return to the landing field

Return to the landing field

Return to the land field is not only a matter of best gliding ratio. The question is should the plane capable to return flight after climbing in a thermal?

After climbing, the plane should be far away downwind at a reached altitude. Should it come back safely? (See Figure 9)

This is then a matter of climb angle (a mix of climbing rate and deviation to follow the thermal movement) and angle of descent upwind. The quicker the climb and the better the gliding ratio are, the higher is the chance to return home.

The ability to take the lift gets once again its importance with all the consequences on plane definition.

Landing

Landing means reach the spot every times. Despite the pilot agility, the plane must have specific requirements:

- Stop quickly when landing. In order not to destroy the propulsion unit, I would recommend not to land as F3J planes. Since it is not possible to affix any stop feature, the only remaining solution is a tail that continues under the fuselage like for the AVA / Bubble Dancer, F3K planes…
- Have good maneuverability and good stability in order to pass through ground turbulence and reach the spot. Maneuverability and passing through turbulence without any affect are quite opposite. Since there are great advantages for all the other phases to have very low inertia, the plane should have very good maneuverability as compensation.

Here, it is a matter of rolling rate, braking efficiency, descent angle at a fixed speed. Consequences are on inertia, flap and aileron sizing, inertia (construction issues are once again important…) and also high dihedral in order that wing tips do not touch the ground prior landing...

Classification of trigger plane element

Let's take all of the plane parameters and estimate their consequences (in terms of advantage / disadvantage) for the five flight phases.

Of course, for F5J, the first phase (reaching altitude) could be forgiven since it has no influence on the plane. But this is not the case for most of the other gliding categories.

This provides the following table for the majors. But you can complete it by any parameters you want. (See Table 3)

As you can see, there are three categories of parameters:

- The very important ones. In this first category are found two dynamic stability parameters (on pitching axis) and only one static parameter (wing span). This means that despite what was usually admitted, the most important thing is to have a very stable and well balanced plane.
- The important ones. Quite close to the first category in terms of importance, are found other dynamic parameters such as yawing, inertia. Then are coming what we can call the "standard plane parameters" (fuselage length, mass, profile curvature...). Once again we have to point out the very high importance of the dynamic behavior for a F5J plane. This is not the only category that may have similar classification. But very few planes are studied in this way. AVL and XFLR5 are here to improve our design.
- The others. It is quite surprising to see parameters like drag, gliding ratio, aspect ratio... at the bottom of the classification. Is it so surprising? Look at an eagle and look at a sea gull. Two birds, two types of flights, two adaptations to an environment. So don't be so surprised.

After the Pasmespumas and the Genoma, here is my new F5J plane: The Genoma²

After a first trial with a modified F3B (with a very long fuselage for good yawing stability) which shows the interest of yawing stability calculation, I developed a series of profiles specifically for the F3J category. The idea was to promote speed (and then small airfoil curvature and very low thickness), high aspect ratio (to compensate the lower airfoil lift by reducing the induced drag and lift). The objective was to be better than the Supra in speed and transition. We constructed it in a few exemples. I put all

F5J

		Reach altitude with motor			Thermal searching			Altitude gain in lift			Return to the land field			Landing				
	Donnée	Flight phase ponderation	Note (1= Positive, 0= neutral, -1= Negative)	Flight phase note	Flight phase ponderation	Note (1= Positive, 0= neutral, -1= Negative)	Flight phase note	Flight phase ponderation	Note (1= Positive, 0= neutral, -1= Negative)	Flight phase note	Flight phase ponderation	Note (1= Positive, 0= neutral, -1= Negative)	Flight phase note	Flight phase ponderation	Note (1= Positive, 0= neutral, -1= Negative)	Flight phase note	total	%
18	Good pitching stability	0	0	0	15	1	15	24	1	24	8	1	8	3		0	47	7%
19	Low pitching stability margin	0	0	0	15	1	15	24	1	24	8	1	8	3		0	47	7%
1	High wing span	0	0	0	15	1	15	24	1	24	8	1	8	3		0	47	7%
9	High tail volume	0	0	0	15	1	15	24	1	24	8		0	3	1	3	42	7%
10	High fin volume	0	0	0	15	1	15	24	1	24	8		0	3	1	3	42	7%
17	High yawing stability	0	0	0	15	1	15	24	1	24	8		0	3	1	3	42	7%
3	Long fuselage	0	0	0	15	1	15	24	1	24	8		0	3		0	39	6%
5	Low mass	0	0	0	15	1	15	24	1	24	8		0	3		0	39	6%
7	Low wing load	0	0	0	15	1	15	24	1	24	8		0	3		0	39	6%
11	High profil curve	0	0	0	15	1	15	24	1	24	8		0	3		0	39	6%
13	High max CZ	0	0	0	15	1	15	24	1	24	8		0	3		0	39	6%
16	High CZ3/CX2	0	0	0	15	1	15	24	1	24	8		0	3		0	39	6%
4	High flap size	0	0	0	15		0	24	1	24	8		0	3	1	3	27	4%
2	High aspect ratio	0	0	0	15	1	15	24		0	8	1	8	3		0	23	4%
14	Low CX	0	0	0	15	1	15	24		0	8	1	8	3		0	23	4%
15	High CZ/CX	0	0	0	15	1	15	24		0	8	1	8	3		0	23	4%
12	High profil thickness	0	0	0	15		0	24	1	24	8	-1	-8	3		0	16	3%
6	High mass	0	0	0	15		0	24		0	8	1	8	3		0	8	1%
8	High wingload	0	0	0	15		0	24		0	8	1	8	3		0	8	1%
20	High rolling rate	0	0	0	15		0	24		0	8		0	3	1	3	3	0%

Table 3: Aircraft parameters and consequences for five flight phases

of the information for the construction on a 200 illustrated pages (French language actually only, sorry). For those interested see the website <http://www.xerivision.com> for more details. We measured its performance and I have to confess that this is quite a satisfaction to obtain a plane that corresponds exactly to the calculation. I wanted it, I obtained it, and I love it. This plane is the best plane I have ever piloted. (I have constructed more than 100 planes.) (See Figure 10)

Then came the F5J category and I restart from scratch my studies taking into account new considerations such as minimum weight for a defined aspect ratio and G load, minimum circling diameter...

This conducts me to the GENOMA².

It is similar to the Genoma, but quite different for some aspects:

- Less aspect ratio to reach the 20g/dm² wing load,
- higher camber for the profiles for lower minimum speed,
- lower minimum wing load,
- more span (4m) to be at the maximum of the F5J regulation,
- a new series of profiles taking information from the Pike perfect, the Supra, the AVA...

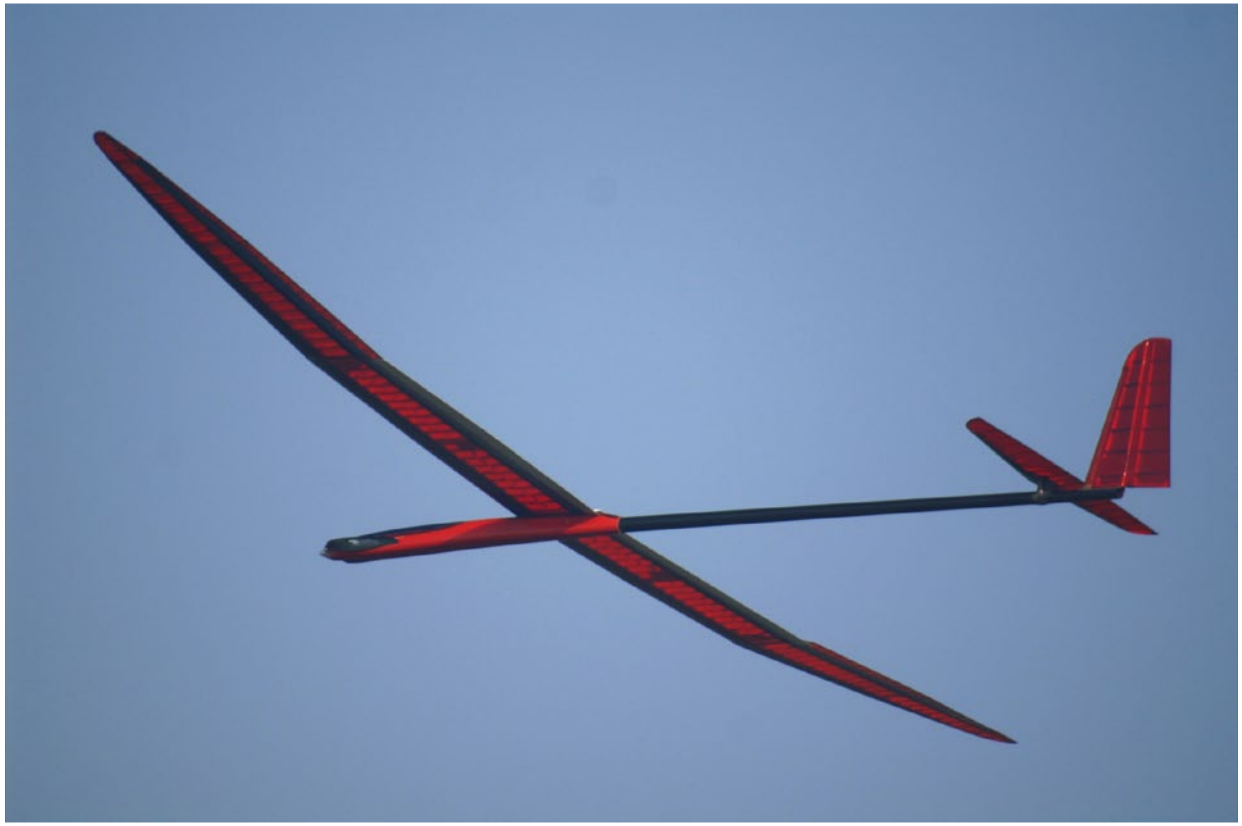


Figure 10: The GENOMA as defined in 2010. It flies like a F3K plane with a 3.65 m span.

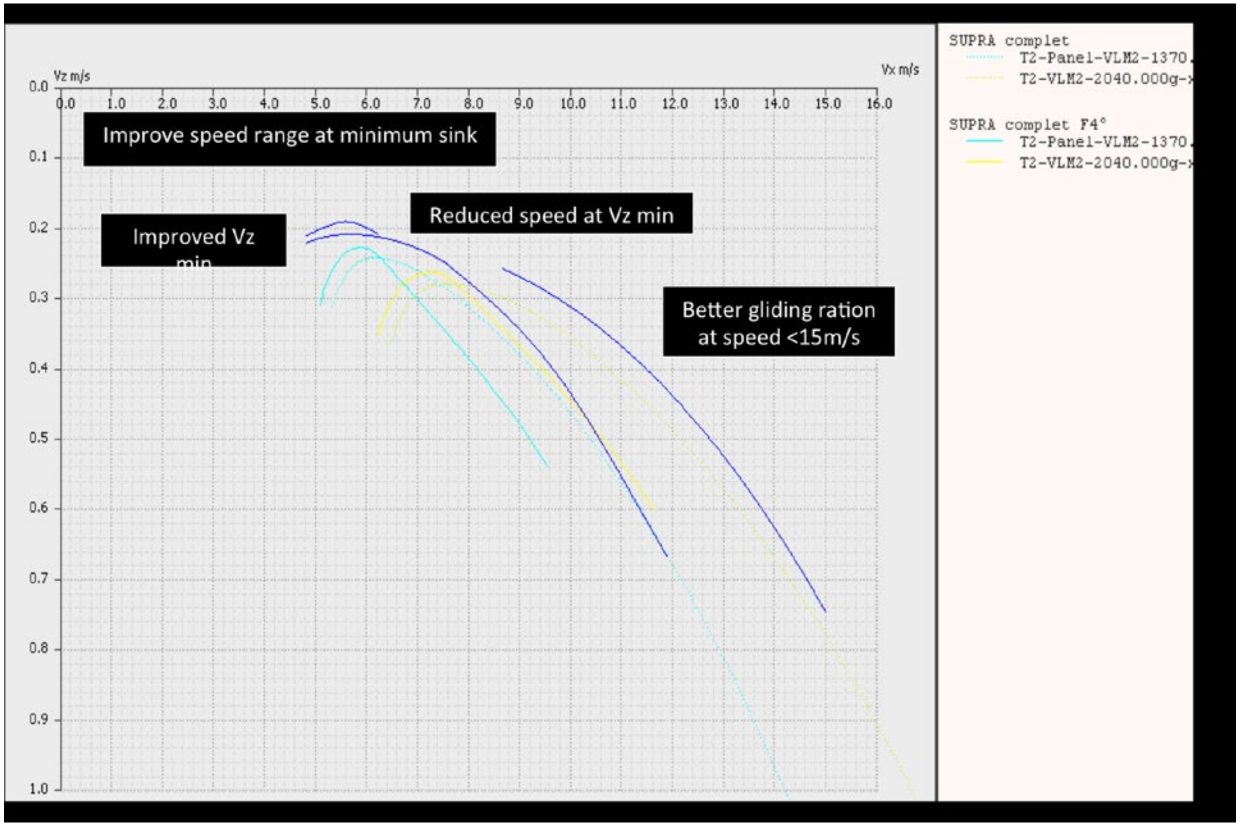


Figure 11: Comparison polars

- a new fin and tail to adjust dynamic behavior.

The objective was:

- To improve speed range at low sink rate in order to avoid stall during circling. In this respect, the Pike perfect was taken as a reference.
- To improve Gliding ratio between minimum sink and 15 m/s. The Supra is taken as the reference for this aspect.
- To improve low speed.
- To have the same or even better yawing and pitching stability than the Genoma.

This provides me with the planform shown in Figure 12 (next page), with an associated profile series (icons and links on next page).

The length of the fuselage is the same as for the Genoma for transportation reasons, 2.2m long, that's for me nearly the maximum. Otherwise it is difficult to store it at home or in the car without risk of damage... And I don't want yet to make a fuselage in two pieces.

Dimensions are:

- Fuselage from nose to leading edge: 53 cm. Don't think this is too much. When using a 105g / 700W geared

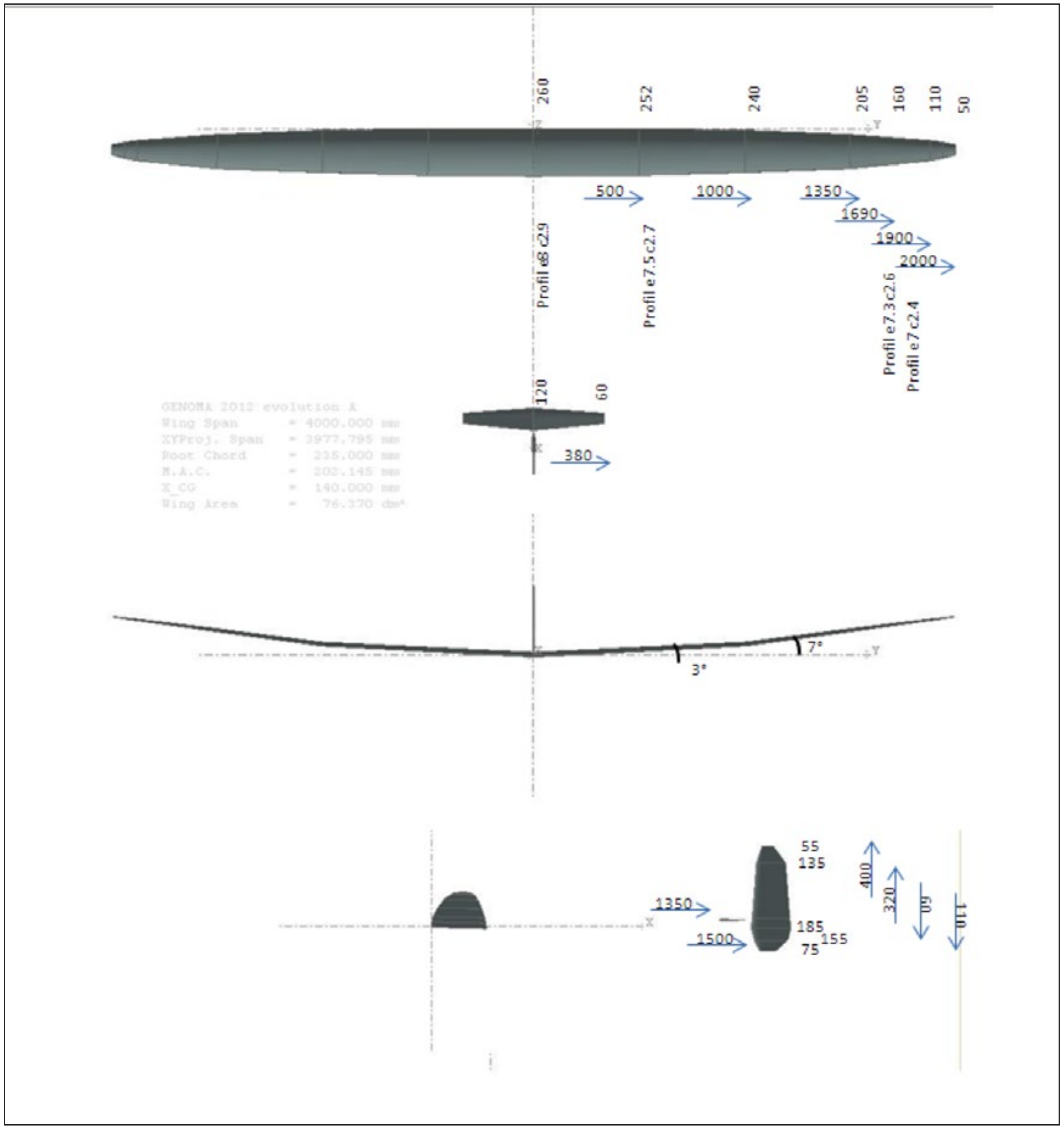


Figure 12: Genoma² (2012)

<u>Genoma² Airfoil Series</u>

Genoma F5J 1: <http://www.rcsoaringdigest.com/Airfoils/Genoma2/GENOMAF5J1.dat>

Genoma F5J 2: <http://www.rcsoaringdigest.com/Airfoils/Genoma2/GENOMAF5J2.dat>

Genoma F5J 3: <http://www.rcsoaringdigest.com/Airfoils/Genoma2/GENOMAF5J3.dat>

Genoma F5J SAUMON: <http://www.rcsoaringdigest.com/Airfoils/Genoma2/GENOMAF5JSAUMON.dat>

motor and a 1300mA/h 3S Li-Po battery (or even a 2200mA/h 3S Li-Po), this is not too much. This is just sufficient for the very long rear lever arm.

- Fuselage from wing leading edge to the end (fin trailing edge): 166 cm
- Max section dimension of the fuselage: 6*4 cm
- Wing area: 85.56 dm^2
- Root chord: 26 cm
- Aspect ratio: 18.7.
- Max diameter of the boom = 34mm. Of course you can reduce this diameter in order to be lighter. But caution with the fuselage flexibility...

Wing data and profiles:

- Root: Dihedral = 3° - Chord = 26cm - Thickness = 7.8% - Camber = 2.9%
- Root + 50cm: Dihedral = 3° - Chord = 25cm - Thickness = 7.5%; Camber = 2.7%
- Root + 100cm: Dihedral = 7° - Chord = 24cm - Thickness = 7.5%; Camber = 2.7%.
- Root + 169cm: Dihedral = 7° - Chord = 16cm - Thickness = 7.3%; Camber = 2.6%
- Root + 190cm: Dihedral = 7° - Chord = 110cm - Thickness = 6.8%; Camber = 2.4%
- Root + 200cm: Chord = 5cm - Thickness = 6.8%; Camber = 2.4%

Flaps are 30% of the chord from the root until 15 cm prior to the tip. Then the aileron is gradually reduced down to 20%. Flap and aileron are "on the same line" looking at the plane from the top.

Tail:

- Surface = 6.8 dm^2 (8% of wing surface). But look at the comfortable tail volume.
- Tail leading edge distance from wing leading edge = 1315 mm
- Root chord = 12cm
- Aspect ratio = 8.4
- Tail volume = 0.47
- Profile = HT-13

Fin:

- Surface = 7.4 dm^2
- Fin leading edge distance from wing leading edge = 1500 mm
- Root chord = 18.5cm
- Height = 55cm (including 11 cm under the boom)
- Profile = HT-13
- 50% of the surface makes the rudder. This is a minimum. You can go up to 60% without a problem but with benefits.

<u>The GENOMA² construction</u>

There are 20 moulds made for the Genoma. We planned initially 21, but finally limited the number... Quite a lot I know. That's why the Genoma was started in a club. One guy is doing this, the other one that…

We then succeed without much difficulty to create these moulds in less than 6 months. And in one year of construction, the Genoma was flying. Of course, for the Genoma² I reuse all of the moulds, even if the profiles are a bit different. The D-box is quite flexible so there is no adaptation problem.

For details, look at the 200 pages (in French, sorry, but with lots of photos) written at www.xerivision.com (this is not my website). (See Figure 13)

Tail and fin

The spar of the fin and the sub-fin is realized with a carbon rod 3*0.8 mm on upper and lower side. The spar caps are made with balsa. After it has been glued together (Cyano), a Kevlar fishing wire is rolled around. Then balsa profile leading and trailing pieces are glued. The trailing edge is made with a carbon rod 3*0.8 mm and the trailing edge is covered with a small sheet of carbon (cut from a unidirectional 80g/m^2 carbon layer).

The leading pieces are glued every 1.5cm and the trailing pieces can be glued every 4.5 cm. (See Figure 14)

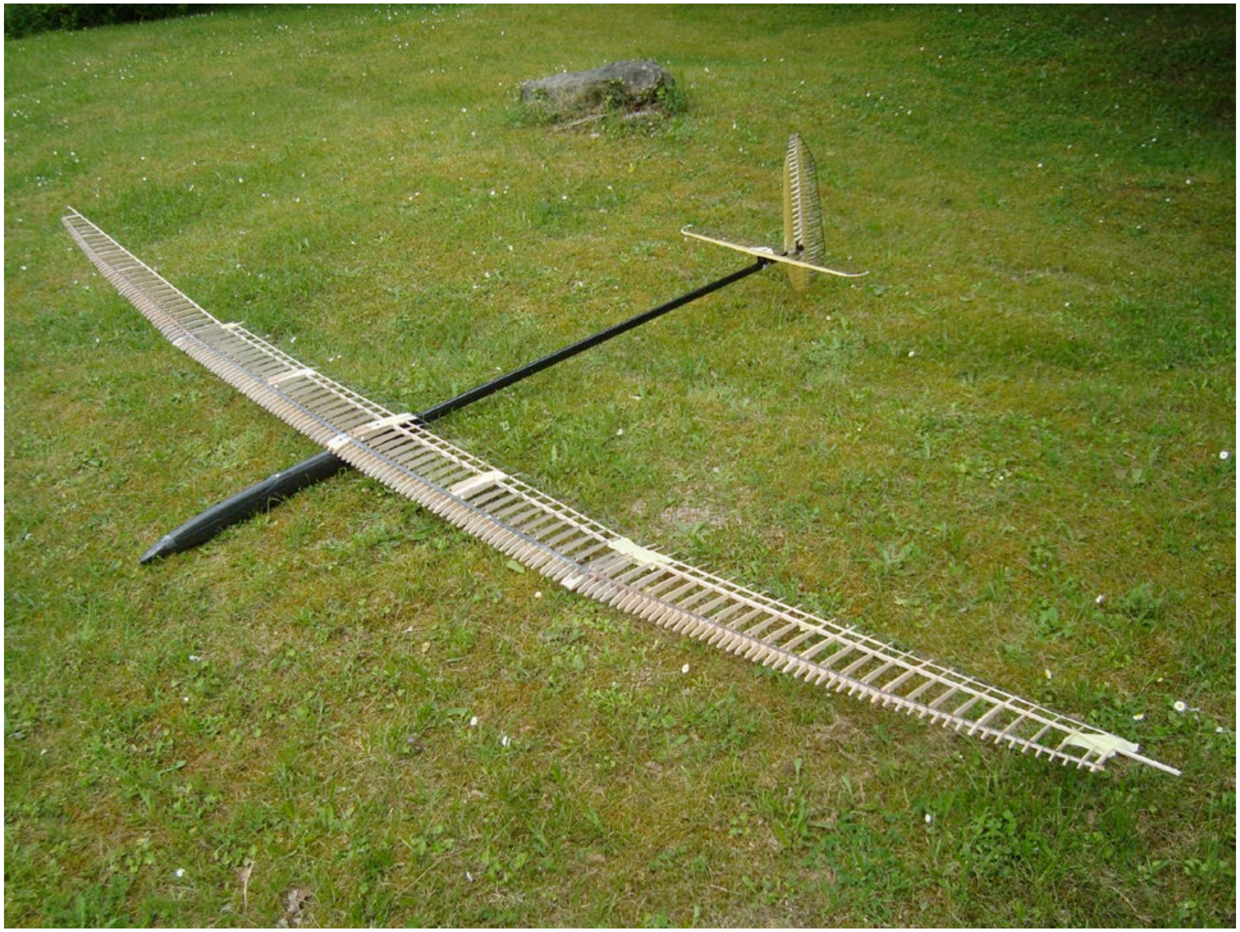


Figure 13: The Genoma² prior to recieving its composite D-boxes. This is quite long to proceed but not very difficult at all. Nothing requires many tools (We used a CNC machine for cutting the profiles, you can do without).

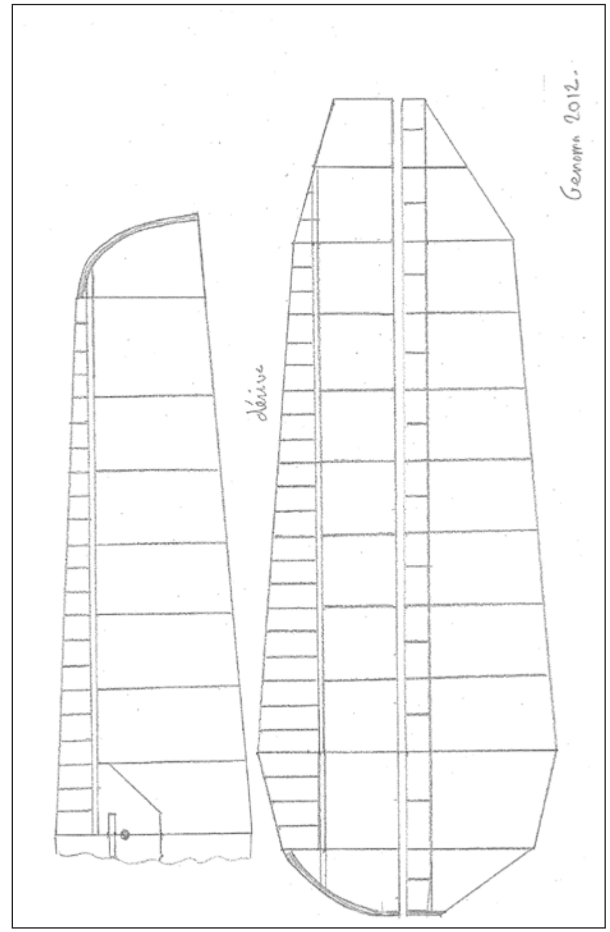


Figure 14: Stabilizer (L) and vertical fin and rudder (R) drawings.

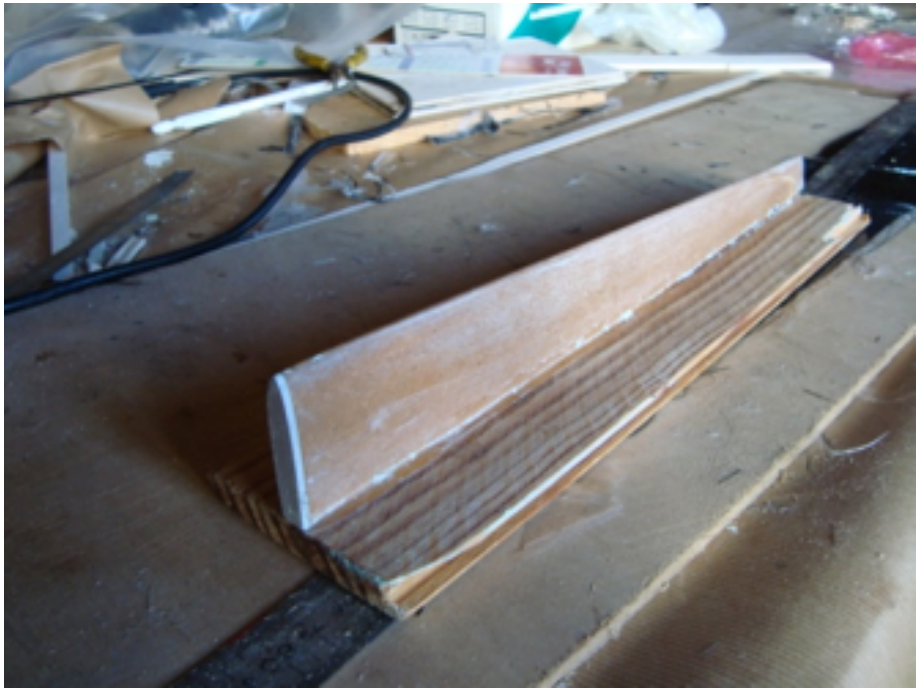


Figure 15a and 15b: How to mould the D-boxes? Easy. On a positive mould. Not much science behind this. For the wing, two layers of Kevlar of 60g/dm² is fairly sufficient (the wing can support all aerobatic maneuvers). For tails and fin, a 60g/dm² kevlar is OK.

The D-Box is made with a sheet of Kevlar (60g/dm²).

Do not forget the D-box for the rudder. It has a very important role. 1.5cm large is sufficient.

The secret of the D-Box is in the glue to assemble it. There is always too much glue! If you count at the end, this glue represents up to 25% of the total weight. Far too much for a so little resistance. Try to reach 10 to 15% and you will be a king.

(See Figures 16 and 17a and 17b)

Wing

The wing is a tail that is a bit bigger. That's all… But the techniques used are identical. (See Figures 18 and 19)

The spar is made with two layers of carbon sheet 15*1mm at the root. Then after 500mm, only one layer remains. The spar is also tapered down to 2mm at the tip.

Leading profile pieces are glued (Cyano) every 2cm and the trailing edges every 4cm.

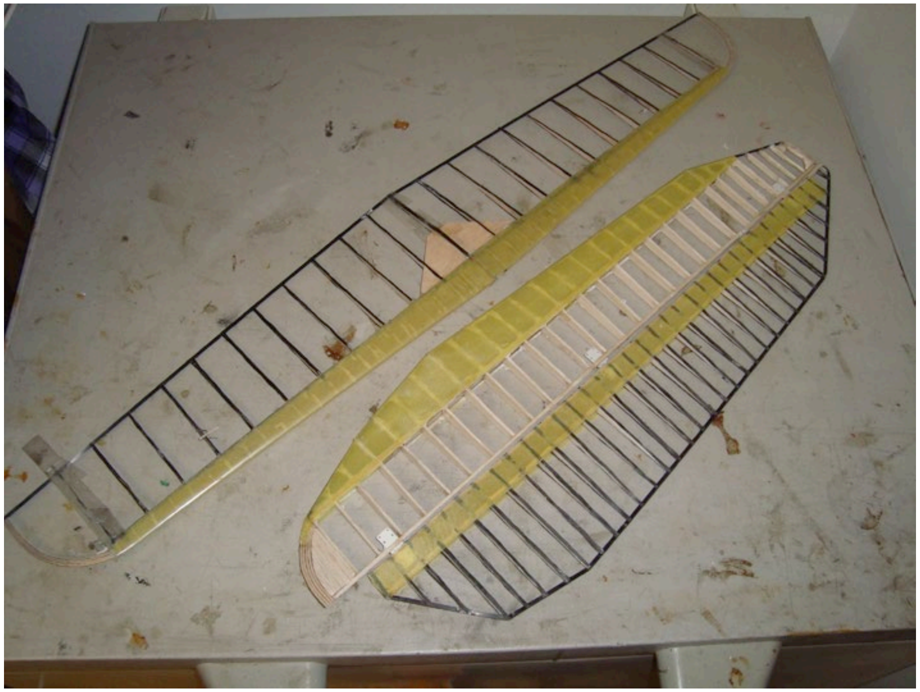


Figure 16: Tail and fin. Making them lighter and stronger is difficult but possible. There are too many wood sticks in the fin. We can suppress 2/3 of them for the rudder. But this was for the look!

Figure 17a: Vertical fin and rudder and horizontal stabilizer mounted to fuselage before covering.

Figure 17b: Vertical fin and rudder and horizontal stabilizer mounted to fuselage after covering.

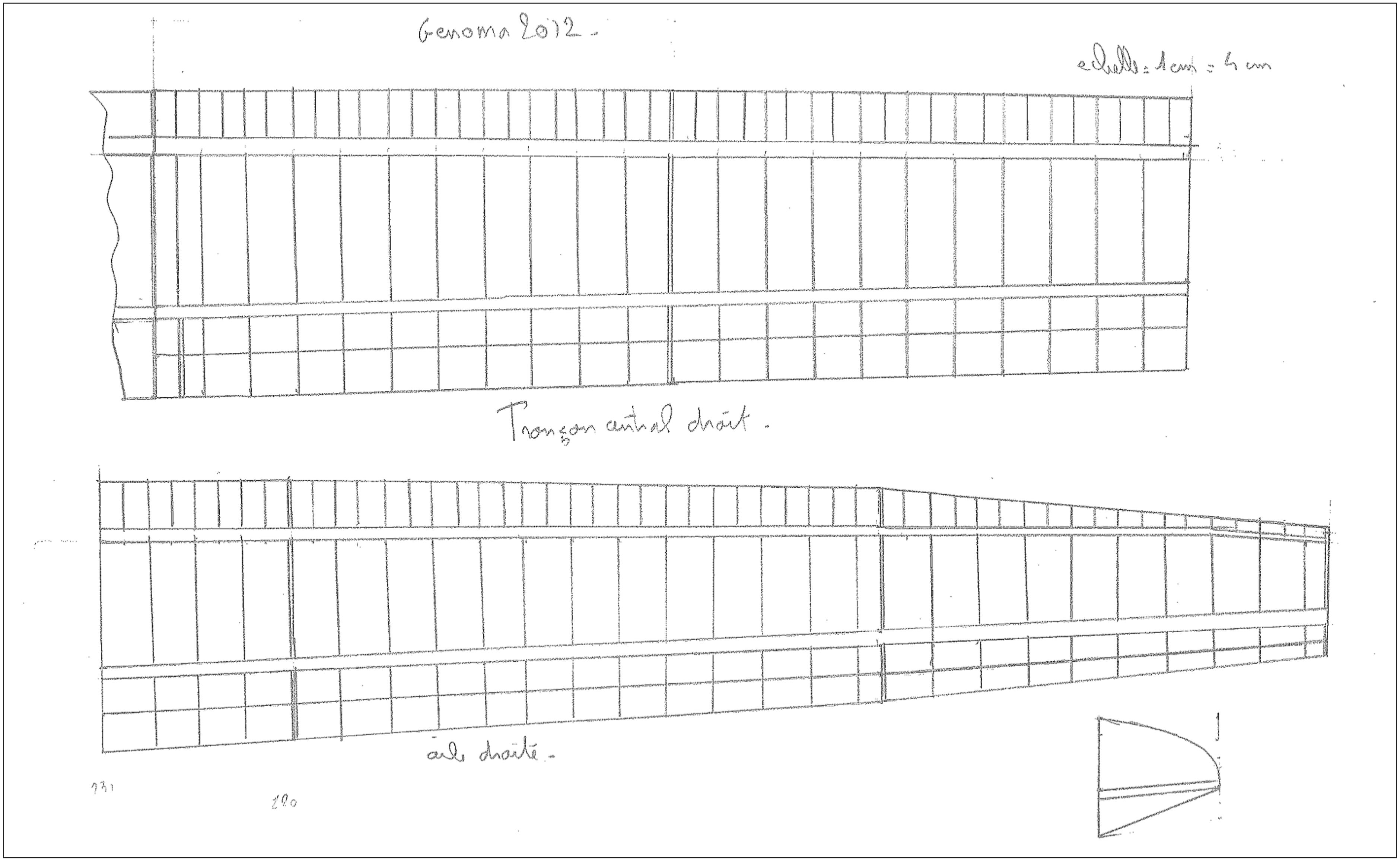
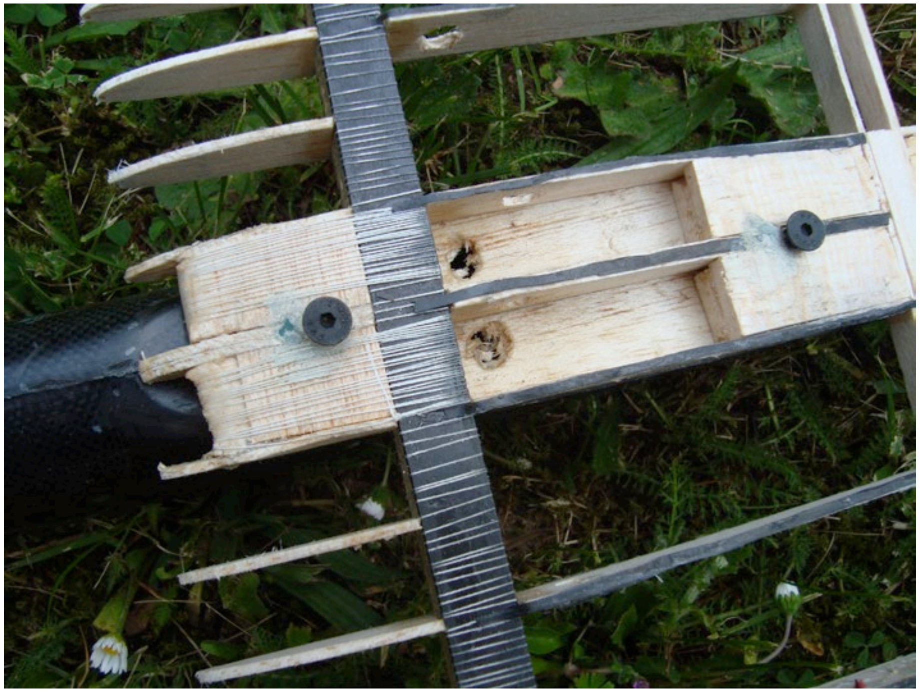
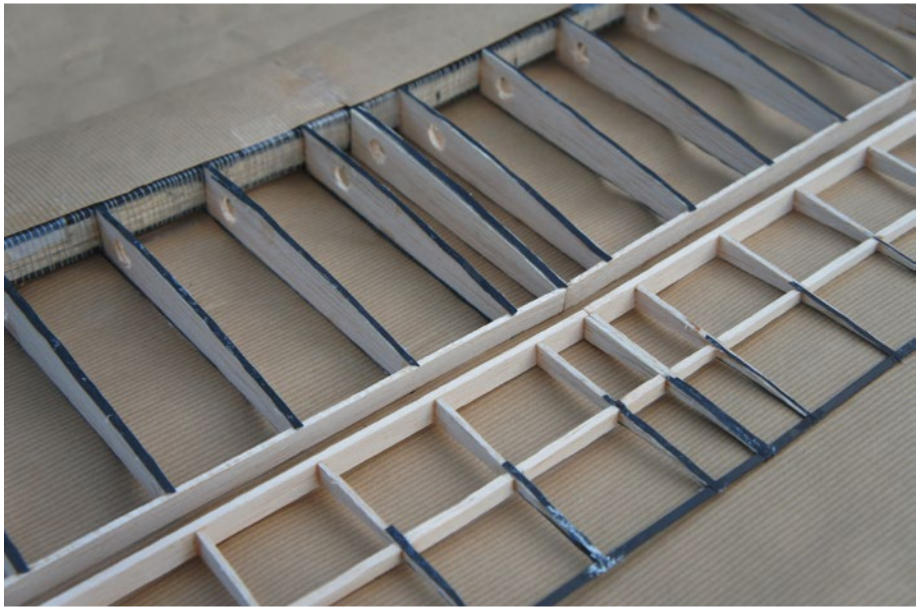


Figure 18: Wing plan

Figure 19: All balsa wood pieces have been realized on a CNC machine. Of course, on request, files can be provided.

Figure 20: How to mould the flap and aileron D-boxes — on a window! Do not forget to "wax" it.





Above, Figure 21: Few detail of the wing to fuselage assembly system.

Upper right, Figure 22: General view of the wing. The leading edge is covered with paper for protection reason. It will be replaced by molded D-box.

Lower right, Figure 23: View of D-box mold under process. On top, you can see the D-box bagged, in the center the D-box results and in the bottom of the picture the D-box mold.

Figure 24: A view of the fuselage to better appreciate the design.

Figure 25: The details on how to fix the tail. Very similar as the Supra / Bubble Dancer... Except that here, everything is inside the boom. Everything is made with very rustic moulds (and easy to be made). Nothing difficult!

The leading edge D-box is made with 2*60g/dm² Kevlar layers. This is enough for F5J. The standard 165 g/dm² Kevlar-carbon layer is too much / too heavy for this category.

The flap and aileron D-boxes are cut from a 60g/dm² Kevlar layer that was moulded on a window… (See Figure 20)

Nothing difficult. Everybody can do it with a bit of experience or in a club. It is only a bit long. (The wing requires more or less 30 hours of work if you have the D-box moulds and the wing ribs already programmed for the CNC milling!)

But the result is... Magic! (See Figures 21, 22 and 23)

Fuselage

The Genoma² fuselage is the same as the Genoma.

Total length: 2.2m

Nose to Leading edge distance = 530mm. This is not too much. I strongly recommend not to shorten the nose.

Other dimension: Maximum larger = 40mm, Maximum high = 60mm. Enough place to fix everything you want in terms of propulsion, batteries, servos... The fuselage section is neither round nor rectangular. We prefer an ovoid section as you can see in the pictures.

Wing incidence is 4°, so that the plane flies with a horizontal boom.

This is the flying attitude the Genoma family has. And the fuselage of course remains in this position with flap put down or up.

This horizontal attitude is for me quite important to manage flight when the plane is very far away.

Note: I usually play with the plane flying 600m away (in our field this is where thermals are).

I confess that most of the F3x planes do not have such incidence. But their designs are based on speed. Remember, F5J is not F3J.

The boom is horizontal and the nose has a 2.5° pitch starting at the wing leading edge. (See Figure 24 and 25)

How does Genoma family fly?

The Genoma (First) is quite magic. You play with it like with a F3K plane.

Of course because of the wing span, it is a bit different. The rolling rate is lower, the gliding ratio is far better, but you do what you want when you want in a very small volume. I'm not a great pilot even after I playing with gliders for 40 years, but I still started to circle at 20 m altitude during the second flight.

The next thing to be noticed is that it is very easy to fly. For the last two years it is the plane I use for teaching new pilots. The trainees also learn how to land with it. I use an "Easy Glider" at the very end of my teaching lessons in order for trainees to know how to play with their own future plane! (See Figure 26)

Figure 26: One of my trainees with the Genoma after his flying lesson. They learn everything with it.

Easy to fly means also easy to circle at low altitude. As an example, I circle 10 minutes between 20 and 50 m altitude as if it was a normal flight. Thermal lift was ridiculous, small, but of course quite frequent. And this flight was made without any difficulties. I didn't feel uncomfortable at all during the flight nor exhausted after the flight even if the plane was 100 to 200m away from the landing zone. (See Figure 27)

One of my favorite ways to fly in a thermal is to play with the "hand brake" when turning (like with the car): When circling in the downwind branch, the rudder is put at its maximum. The

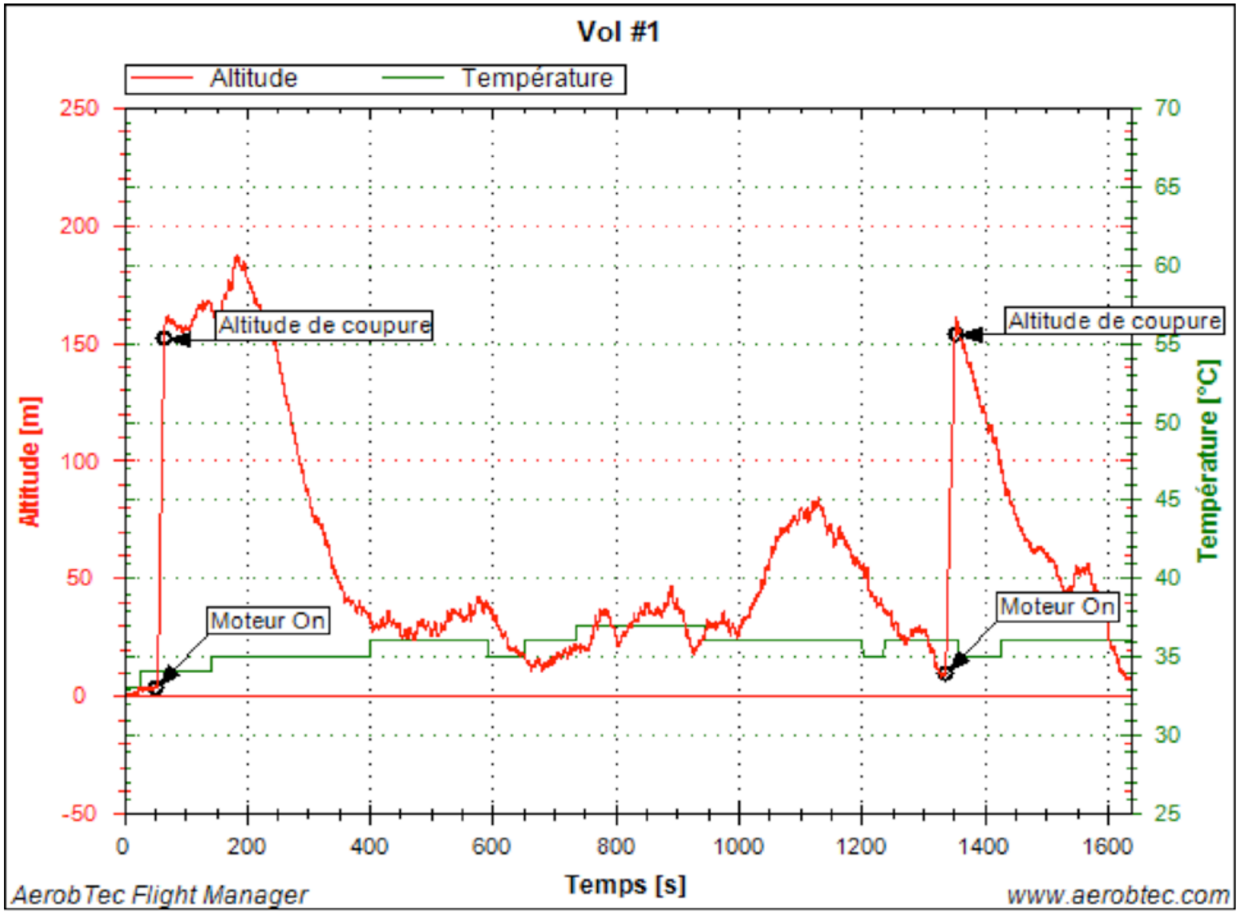


Figure 27: The proof that the Genoma can fly at very low altitude. And “No fear, no fun” is not my motto.

ailerons are in the opposite direction so as to maintain a flat attitude. The plane is turning on its wing root, like a car with the hand brake. A bit of pitch when being upwind, then aileron order to restart the turn...

When done in the very core of the lift, the plane has a “vertical” trajectory... Interesting, no?

Another refinement I’m using now is the fourth axe management. I play with the camber of the wing all along the flight. Instead of using pitching throttle (left stick), I prefer to use the camber one placed on the right stick. The speed variation is as with the left stick but the plane fuselage remains horizontal. This is marvelous during circling. You “push” when you are going upwind, and pull when going downwind. The pitching axis is used to maintain the circling radius and the camber one manage the flight speed. The plane then circles in a very smooth and regular circle without having much pitching order to be provided. And the fuselage remains in the same position (horizontal) which is once again fundamental to better feel the thermal. If you had used the pitch, the fuselage attitude would have changed due to your pitching action… (See Figure 28)

Figure 28: The Genoma in flight. The fuselage doesn't appear so long does it?

In terms of yawing behavior, measures and computation are very close. Again, "Magic"! (See Figure 29)

What about Genoma² flight

The new Genoma² is as expected from calculation.

It flies as its older brother:

- It is a F3K plane but with 4m span. This means that the way to fly it similar to any F3K plane with of course more inertia (more time to roll).
- It has this ability to circle very shortly. And in this respect this open new way of flying; On top of the standard "gentle circling" way of flying with very smooth actions on the sticks that you need to master for TD flight, the Genoma family allows to have a more aggressive way of flying without much difficulty. This is quite useful at low altitude when the thermals are narrow and not very regular. Here, the yawing stability behavior is a real advantage compare to any other planes.
- It is a full aerobatic plane. Loop, roll, invert flight, chandelle are easy. The first ones (1 loop + 1 roll + 1 chandelle) were made starting at less than 50m altitude… and of course finished by a landing close to the pilot.

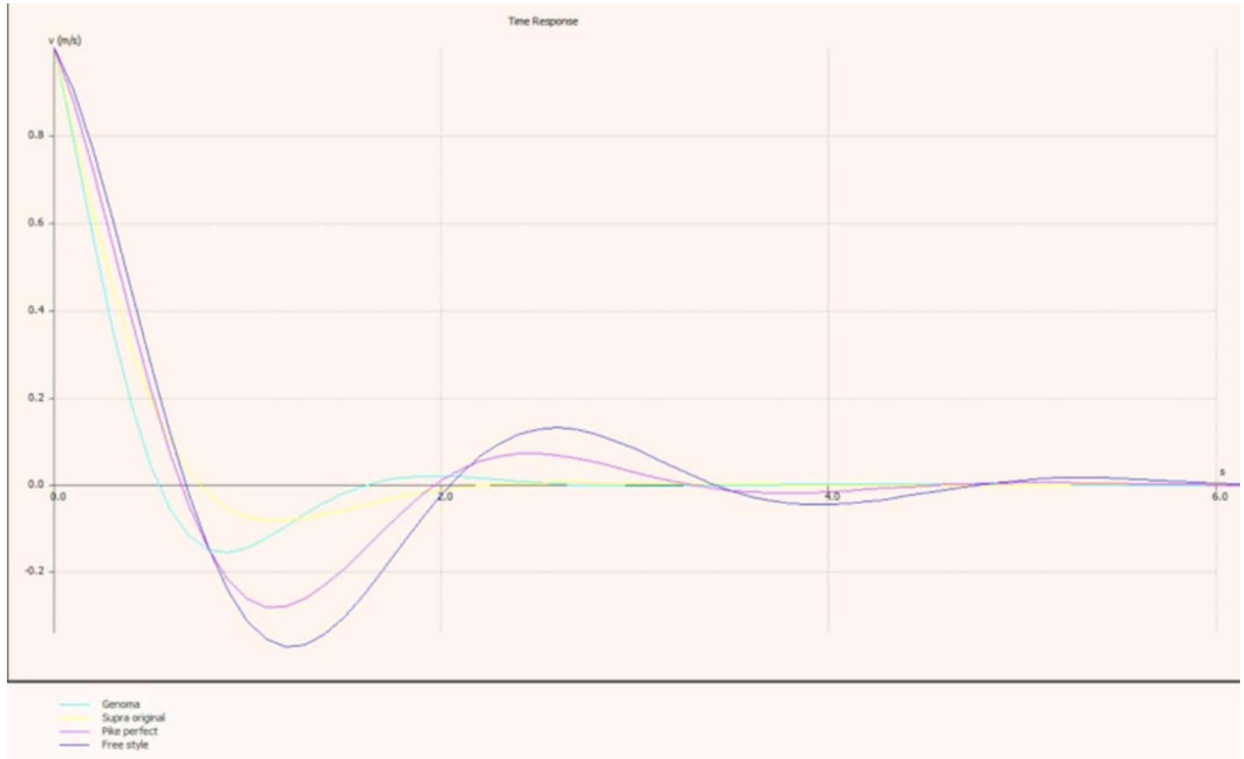


Figure 29: Comparison of different planes in yawing. The Genoma (in light blue) is far better than any other planes (Supra original in yellow, Pike Perfect in purple, F3B plane in dark blue) which provides it with very good circling ability. The Genoma² is of course as its older brother.

Figure 30: First flight of the Genoma (First version) was in January 2010. Since that time, this 1.9kg plane flies every week without trouble. It even succeeds to flying three minutes alone (without any control due to an electrical problem) and crash in a field after a 50m dive without any destruction. So light and so resistant!

Figure 31: The man is 1.93m long. Quite a plane, no? The Genoma² weighs 1.6-1.7kg. It is 300g lighter than the Genoma for greater span and surface... The Genoma² is also able to make the barrel rollss in circles or any other aerobatic maneuver.

- Stalling is difficult with a radio mix "Elevator" -> "Camber." In such condition the stall is a 5m loss of altitude with recovery after. And if you insist, it starts for another cycle of stall/lost of altitude/recover. Then the only way to escape is to use the butterfly airbrakes.

On top of this abilities are:

- The potential wing load range of 19 to 35g/dm² which is optimum to any flight condition. As a consequence, the circling radius (minimum 6m compared to the 10m for the Genoma) and the minimum speed and sinking rate are improved.
- The sub-fin acts as a stopper during landing. The grass "sliding" is only 50cm. That's better than the 2m to 3m for the first version. I wondered whether the fuselage and sub-fin attachment will be strong enough. For "standard" and "nearly standard" landing (that's what I made actually), nothing adverse happens.

As already expressed, it is very difficult to measure minimum sinking rate or best gliding ratio. It depends so much on air conditions that you can say one thing and it's contrary. I then will not provide values that don't mean anything. Just to say that with 30km/h wind, the Genoma² without ballast stays in the sky with a “standard” sinking rate (as for any other planes for such wind that obliges to fly at best gliding ratio and not at best sinking rate). Of course, with such wind, it is recommended to have 500g to 800g ballast for better penetration / gliding ratio. In this case Genoma and Genoma² are quite equivalent. Differences could not be measured for me.

<u>The Genoma² in its first TD F5J contest</u>

After only two flights in 30 to 40 km/h wind, I made an F5J contest. The plane had never been ballasted, circling had not been tested, flap compensation was not well triggered, airbrakes and precision landing never tested.

Because F5J is a new discipline, only few contests occur in my area. I had then to participate.

I also have to state that I’ve only made competitions two times in my life. The first one was in 1980 (I finished last) and the second in 1982 (I finished third but we were only three competitors and I crashed my plane on the first flight). So, in reality I consider that it was my real first Thermal Duration (TD) contest.

Because of the pressure and the very few number of flights with the Genoma² I wanted to start with the Genoma. But

Figure 32: The Genoma² (facing the camera) and the Genoma ready for flight.

then the first failure occurs during a flight test: a flap servo failed. Thanks Mister Murphy! I then have to fly with the Genoma² which you will recall had only two flights since new... Not a good way to start a TD contest.

Other competitors had made competitions for years (F3J, other TD types...). Gliders used were Pike Perfect, Maxa, AVA, Shadow, Electra, Graphit, Alfa club and homemade planes including the Genoma².

Conditions were good with low wind (10 to 25km/h wind) which obliged the lightest planes (Maxa and Genoma²) to ballast a bit when the wind went up (+ 250g). The AVA didn't have ballast capability which was a disadvantage in some flights. All other planes had wing loadings between 27 and 35g/dm² and didn't require ballasting.

I was then quite impressed and anxious for the first run.

I then flew and discovered that the plane is very good, and even without thermals, did equal with the others. My first landing was not so good because I didn't know how the plane reacted or how to land on a spot...

Then all the other seven flights proved to me the following:

Figure 33: Genoma² for its first flight. Except few adjustments, it flies perfectly and I found immediately comfortable. It is even better in circling ability due to the possible low wing load (19g/dm² without ballast). Of course things needs adjustment (compensation, trim…).

1) The Genoma is better than any others in circling. It flies like an F3K plane and of course can also fly like an F3J plane. This ability to circle in an aggressive way in a very low volume is a real and major advantage for a TD competition. And then, my analysis in this respect is really valid. With thermals, the plane always went over the others or at the same altitude. The Genoma^2 opens a new flight envelope compared to existing 3m to 4m span gliders. And I'm not an expert in thermal hunting!!!

2) Transition: The plane is as good as the others. I didn't play much with flap during transition because of the flap compensation adjustment was not correct. But I've never been trapped downwind as the AVAs were. What I can say is that the higher camber of the Genoma^2 wing indicates you need to play with the flaps if you want to be as good as a Maxa for example. And of course, a full moulded wing made in accurate moulds are always better than a handmade one. But once again, the costs are very different and for the price, the Genoma^2 is really good.

3) I discovered how to land after the TD contest when I offered other competitors to fly the Genoma^2. It is finally very simple. Plane has to transit back to the spot in order that it reaches a 2m altitude 5m in front of the spot. Then full brake. The plane stops in the air, pitches and falls like a parachute at low and constant speed. It remains agile on all axes and you can adjust the spot. At the very end, pull on the elevator stick and the plane lands flat. The under fin and the low speed immediately stop the plane. As the English say "it's a piece of cake" if you have a few practice sessions.

4) Concerning the sinking rate, it is as good as any others. With real moulded wing it will be a must for sure!

So my landing was not good at all. Two outside, one at 1.2m, the others between 3 meters and 5 meters.

I knew I obtained 1000 points for one run. I miss another one for a stupid misunderstanding with my caller (I thought that only two minutes remained and exited the thermal — I was 100m over all the others — and start my approach back... When I reach 180m altitude (50 m lower than others), I discover that 5 minutes of the flight remains... And no more thermals except very narrow ones... So I get an 8 min 40 second flight.

And finally, I finish the contest in third position... Good for a start isn't it?

So despite the inability of the pilot to manage the sticks correctly, the plane has real potential.

<u>Conclusion</u>

Yawing stability is fundamental for our planes. This was not calculated in the past due to lack of knowledge and tools. But thanks to M. Drela and A. Deperrois, this is no more the case. This could be applied to all our disciplines. Aerobatic planes and F3K already do it. For those who play other games, you can also apply the yawing stability calculation principles. As an example, I made a racing plane with good results. (See Figure 34)

Making our own model is still possible for F5J planes. It's not a matter of expertise but only a matter of time to construct it. This means that this discipline has room for experimentation and that you are not obliged to spend $1000 to $2000 to get a single plane.

The cost of the Genoma is about $400 without equipment. And if you make it in a club, this cost of course could go down.

Yes, this is quite more expensive than making an F3K plane, and then we need to make calculations to predict the result prior to launching the building phase. But

Figure 34: A small racer (1m span, 300w only) where the fuselage length is longer than the span. Despite the fact that this configuration disturbs our minds, it is not so unusual for real racing planes. The fuselage increase allows us to reduce fin and tail dimensions (and then drag) and to increase the stability. Flight is like an arrow —"on a rail."

the flying envelop of a 4m span plane is also far more extended!

The Genoma² has been created taking into account 40 years of gliding calculation experiences, 100 planes constructed (most of them were homemade) with about 25 years for electric TD planes including some for duration records. The Genoma family has already made one to one TD flights with good results. The first competition result is also quite encouraging. You may say that this could come from the pilot itself. But my experiences (and especially my first competition) show me that it is mainly due to the plane itself, and especially to the yawing stability. Of course this doesn't mean that it is the best plane.

If you are satisfied with a defined wing (even I think that the Genoma² is more accurate for F5J, I will never say that actual F3J wings are not good for F5J category), you can then improve your plane by redesigning a fuselage and a fin and rudder for accurate yawing stability behavior. This is then far cheaper than creating a new plane. And tools like AVL or XFLR5 are here to guide us. This will force the builder to propose real good planes and not planes that have commercial interests and fashion behind them.

For those who want to have an up to date F5J plane, the Genoma² is the one you expected. You can then either:

- Copy the Genoma² with the same or similar standard construction (wood and D-box),
- Or use the Supra published building techniques and construct your Genoma²; this will of course work perfectly,
- Or make some moulds with a CNC machine.

If you make moulds (be sure that it is really feasible for a non professional guy to have a plane as light as the published version), I of course encourage you to do so. Only advise me in order to see how I can get one of those wings. Thanks in advance.

We have seen that wing loading is very linked to aspect ratio. This means that if you do not want to have a plane at 20g/dm² without ballast but something more closed to 25 to 30 g/dm². You can play with this parameter. One possible solution is then the Genoma first generation.

So let's fly F5J!

In a future issue of RC Soaring Digest...

Walk-around: Tony Condon's Niedrauer NG-1

Jerome Niedrauer built this glider in the early 1970s with the goal of reducing drag and increasing the performance of a stock BG-12. It is now owned by Tony Condon who says, "The NG-1 is the latest addition to the Condon family glider fleet and is an interesting collection of Briegleb BG-12 and custom made glider parts. Most people can't figureout what it is at first glance, and the best short answer I have heard to describe it is simply "Experimental."

Review

TO3A

from RCRCM and OleRC.com

Andy Page, <balsapalooza@gmail.com>

From designer/pilot Carlos Pisarello of Argentina comes the Toba, a new model for F3B multi task soaring, F3F slope racing, and electric assist soaring. Built by RCRCM in China, the Toba is an affordable sailplane. But make no mistake, it is also a well built model and that makes it a great value. Tobas were flown by the Chinese team at the 2011 F3B World Championships in China. Wing layup options are carbon D-tube and full carbon. The review model, supplied by OleRC <http://www.olerc.com> in Hong Kong, is the full carbon version.

What you get

In addition to the airframe, RCRCM supply machined plywood servo frames for flap and aileron servos, servo covers, flap horn fairings, a ballast tube (for F3F fuselage only), a servo tray, wire harness with Multiplex-style 6-pin connectors, carbon tube pushrods, clevises, wing pushrods, and a towhook.

The frames are sized for MKS DS6125 servos but with small modifications can be made to work with any thin wing servo. This is a nice accessory not often included and the use of wood makes them easily modifiable for versatility.

Oddly, the towhook comes unassembled and with quite a loose fit of the unthreaded steel hook in the aluminum plate. I substituted one of the readily available units from Kennedy Composites.

Specifications and Weights

From the manufacturer's website:

- Wing span: 3085mm
- Length: 1456mm
- Wing airfoil: RCRCM2010-8
- Wing area: 58dm2
- Tail airfoil: RCRCM2010-10
- Flying weight: 2000-2100g

Review model component weights in grams:

- Left Wing: 747
- RIght Wing: 745
- Left Tail: 50
- Right Tail: 50
- F3B Fuselage with nose and tail cones: 208
- F3F Fuselage with nose and tail cones: 215
- Wing Joiner: 104
- Ballast Tube: 25
- Servo Tray: 14
- Wire Harness: 79
- Servo Frames (4): 16
- Servo Covers / Pushrod Fairings (6 pcs): 9
- Tail Joiners (2): 6
- Carbon Tube Pushrods (2): 31 (when cut to required length)

The total F3B airframe weight without hardware or radio gear comes to 1910 grams, or about 67 ounces.

For those of you who wonder about such things as weight distribution, the wing panel CG (finished with servos, covers, and wiring) is at about 40% of the half span.

First impressions

Like anyone else, I could not resist putting the parts together for the first time immediately after unpacking and was pleased to note that both the design and execution of this sailplane are well done. All of the joiners fit precisely right out of the box - a good sign.

While these are purpose built tools for serious competition, it isn't all about mechanics and performance. We like good looking airplanes too and the Toba does not disappoint with its very attractive lines. All the molding is very crisp and smooth. The graphics and colors are striking and not just the same old thing.

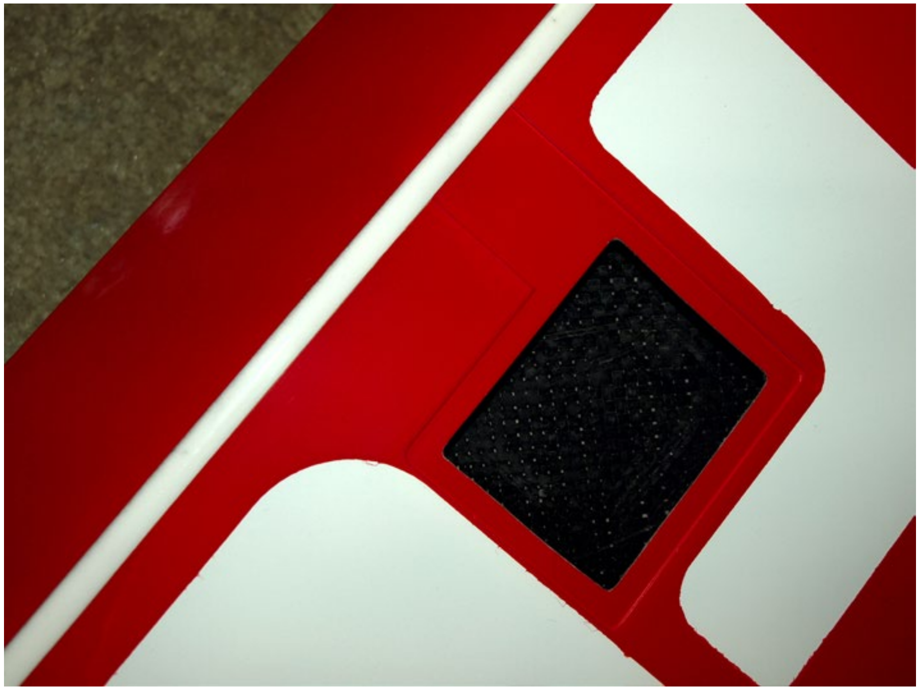
Breaking it down again I moved on to a closer inspection. The molding quality is very good with clean and smooth edges. There is some visible telegraphing of fabric weave and spar edges on the wing panels but nothing unusual or concerning.

The elevators and ailerons stop short of the tips, leaving a small vulnerable area that could be easily damaged. In fact one of the tail tips was slightly cracked already. A drop of thin CA fixed that. Care during transportation and handling will be needed to keep these intact.

Available space for aileron servos is tight. This is a thin wing, measured at 8% at the root. If using the supplied covers,

Complete contents laid out for inspection.

Right out of the box. What a great looking sailplane!



Above: Flap wiper and pushrod fairing recess.

Above right: Top hinged aileron wiper. Lower skin recessed for servo cover with integrated pushrod fairing.

Right: One of the smoothest molded leading edges I've seen. No ridges, no pits.

Below: Wing root. Middle pocket is for ballast.

Supplied flap and aileron horns. Two of these escaped during shipping. Probably would work just fine, but I elected to make the replacements a bit larger for more substantial attachment.

Final parts ready for installation.

any of the typical aileron servos will fit. But if you wish to substitute flat covers you have very little space to work with. The inside height of the bay is about 15/32" at the forward edge and only 5/16" at the aft edge. Space is of course more generous in the flap servo bay, with 13/32" of height at the aft edge. Airtronics 94761's fit nicely there.

Unlike most composite sailplanes these days the ailerons are top hinged and intended to be driven with an external linkage. It may be possible to run the linkage inside but I used the stock setup and covers. Flaps are bottom hinged. The wipers are some of the best I've seen with very tight tolerances to the skin with no interference. Hinge movement is very good with plenty of range of motion and no binding at all.

Two fuselages were supplied with the review package, for F3B and F3F. The F3B fuselage is very small in cross section and sets the wing at a positive angle of incidence. The F3F fuselage appears to have zero-zero incidence settings and is sized about 1/10" taller and wider in order to accommodate the ballast tube. Only one servo tray and harness were supplied. We did not build out the F3F fuselage as of the time of publication, though other than the differences noted above it is identical.

The large cross section carbon wing joiner is typical for a two piece wing. It's hollow, with two spaces on each end that can be used for ballast. It may not have much practical effect but the depth of the cavities on the subject joiner vary by about an inch left to right. Additional ballast cavities are molded into the wing roots. It should be possible to tailor the ballast to load it up without changing the CG. By my rough calculation there is a little less than 9 cubic inches of volume total in all cavities which would give a maximum possible capacity of about 43 ounces of brass or 59 ounces of lead. Tailoring for CG will likely reduce the maximum possible weight.

The wing skins are not pre-cut for flap pushrod exits or for horn installation. Supplied horns are glass and seem rather small for secure attachment. Two of them were lost in shipment, however, so I had no choice but to fabricate new ones. The hardware was packaged in thin, fragile plastic bags which had broken open, and the box was constructed so that small parts could easily escape. Those lost horns might be doing endless speed runs across the Pacific in the belly of a 747.

The removable nosecone is glass but there are four strips of approximately 1/4" wide carbon running through the nose of the fuselage itself. About 4" forward of the aft end of the nosecone the fuselage transitions to all carbon. The nose is open on the bottom rather than the top, keeping the pushrods clear of the wing joiner and your antennae on the best side of the mass of tightly packed radio gear.

The Build

First the flap pushrod exit was created by using a straight Dremel bit to cut the upper skin. The skin is molded with a recess for the pushrod fairing so there is no guesswork here, just cut it back leaving a small ledge for the fairing.

Next, deflect the flap all the way down and relieve the auxiliary/shear spar using a small Dremel sanding drum. The same drum works nicely for relieving the flap wiper.

Since I wanted to make the flap horn a bit longer than stock for the strongest possible connection, I opted to first test fit a pattern cut from 1/64" ply before cutting the circuit board stock.

First I cut a squarish opening in the flap shear web using a #11 blade. A couple of eyeballed trials using scissors to cut the

Now, all you seasoned experts out there already know this, but it might be worth mentioning some tools that are handy for any molded sailplane project that might not be in the typical model airplane shop.

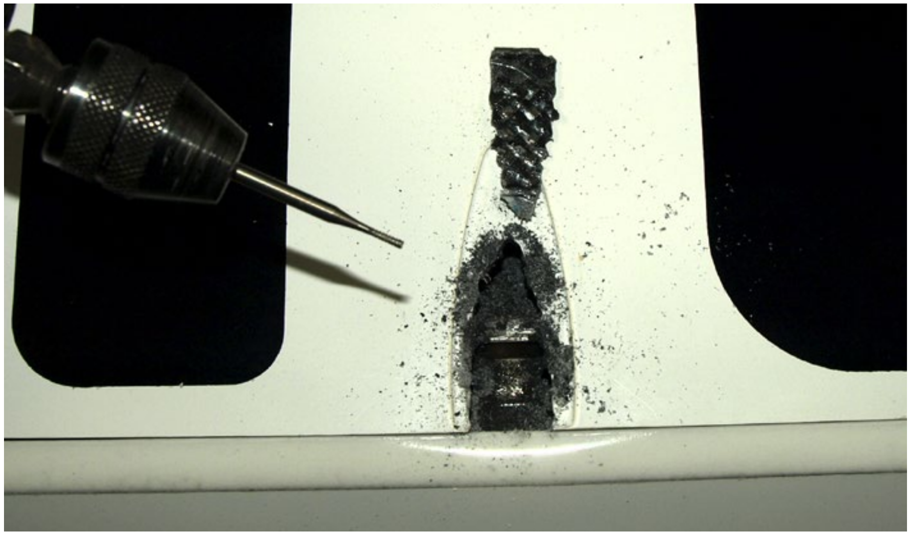
• Riffler files are great for precise access in tight spaces, useful here for roughing up the inside of the nose for gluing in the tray. They're also indispensible for shaping details in composite repairs such as around wing root fillets.

• Chainsaw files, in several small round sizes, are cheap and readily available at any hardware store. Their sharp, fine teeth happen to cut our materials very well. I reach for these more often than any other type of round file. They can do very precise shaping of balsa, plywood, composites, and of course metals. If you cut the smooth end off with a cutoff wheel you have cutting teeth right at the end where you often need them.

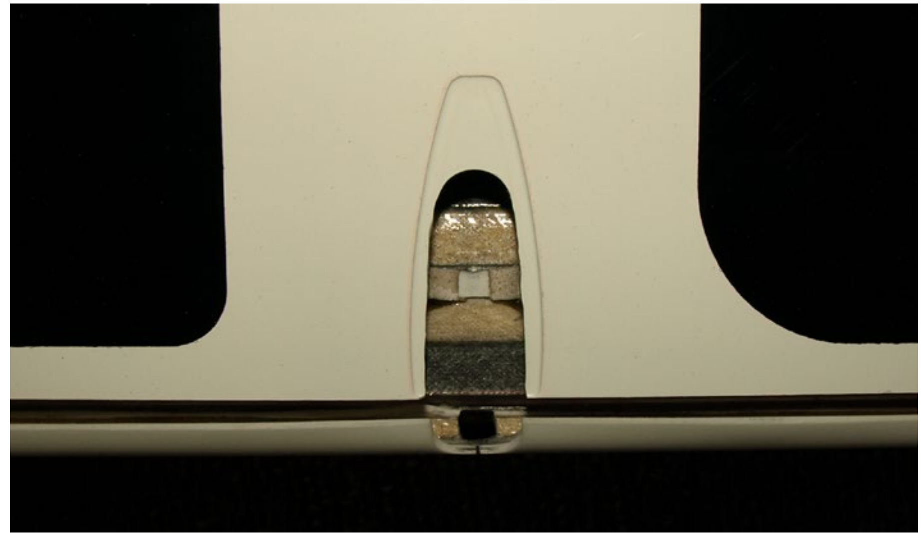
• Woodworking chisels and a small flush-cutting Japanese saw make quick work of precise trimming of wood parts, especially plywood. I used them to enlarge the openings in the thick plywood tray.

This is the only source I could find that has a photo of the Japanese saw. It's in the UK: <http://www.workshopheaven.com/tools/Gyokucho_100mm_Flush_Cutting_Saw_Single_Edge.html>. This is te same saw from a US source: <http://www.hidatool.com/gyokucho-1150-flush-cut-saw-100mm-4>.

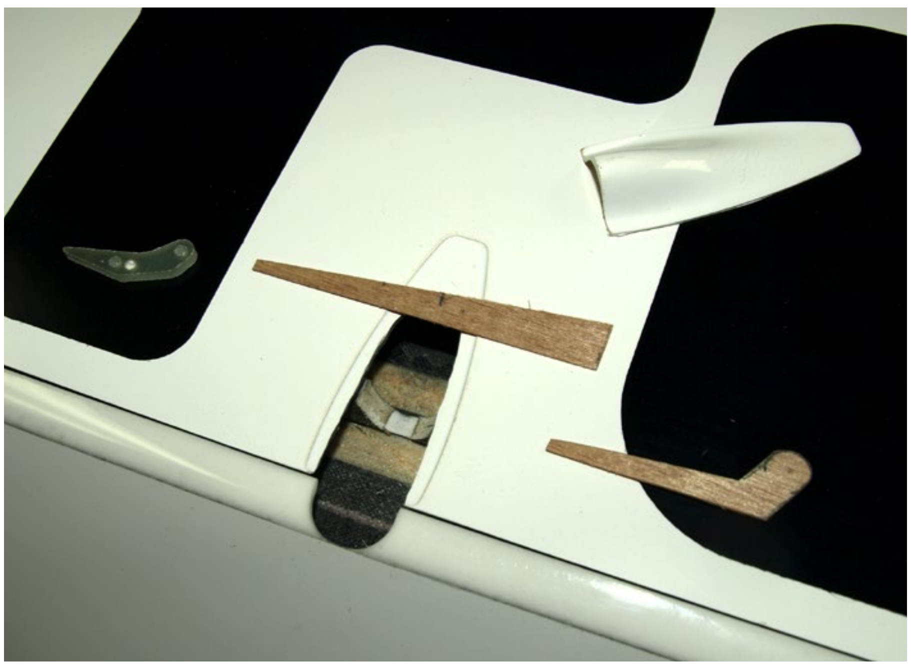
Look for a specialty woodworking store in your area and you'll find many things well suited for model airplane use that you just won't find at hobby shops. For example, the best old school hardware and hand tool store in Seattle and possibly anywhere is Harwick's in the University District. There's not much on their site yet but there is an incredible selection in the store: <http://www.ehardwicks.com/>.



Opening the upper skin for flap pushrods.

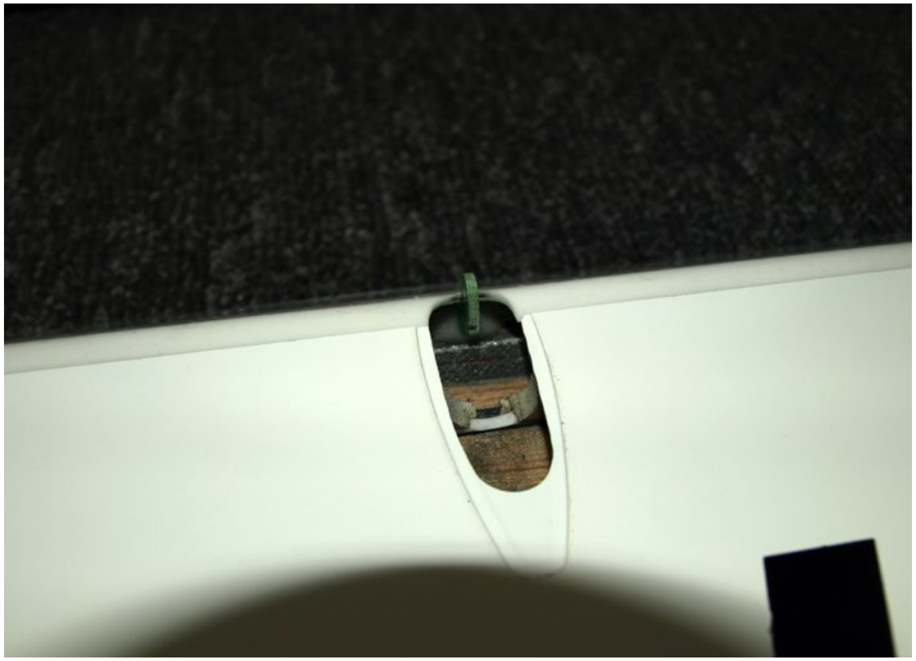


Auxiliary/shear spar cleared for pushrod. Flap shear web opened for control horn.

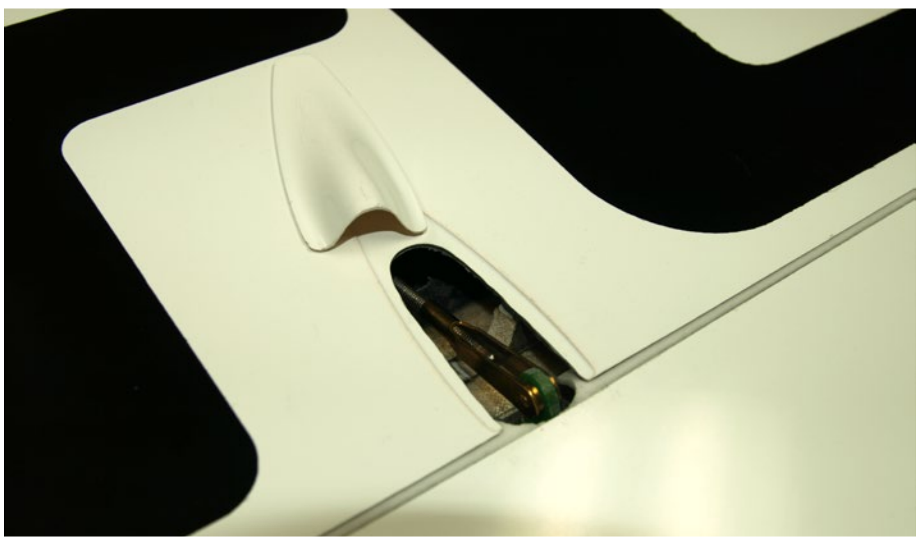


Making a template for the flap control horns.

Checking for clearance and range of motion.



Flap horn installed.



Flap pushrod installed. These are Sullivan clevises and 2-56 threaded rods rather than the supplied hardware.

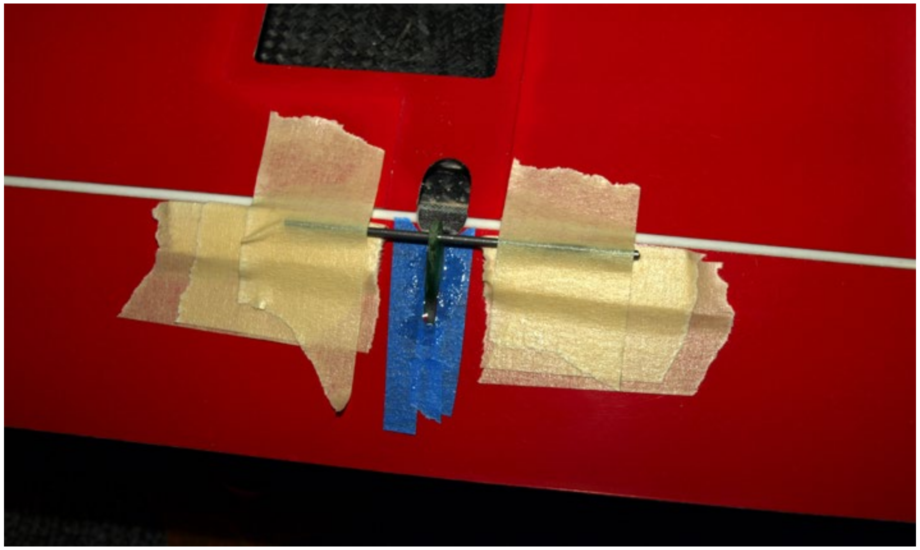
ply and I had the right shape to fit inside the flap and contact both the upper and lower skins. Tracing that wedge shape to fresh ply stock I added the horn as a best guess. After a little trimming to make sure it fit under the fairing and would provide the required range of motion, it was done. Make sure it doesn't hit the lower skin when deflected for up flaperon movement. The final template is shown in the photos.

The circuit board stock was cut roughly to shape with a Dremel cutoff wheel then finished with a disc sander and files.

Aileron horns were done similarly but did not need the leg to fit into the surface. They are just a standard triangular shape. Thickened epoxy holds them all in.

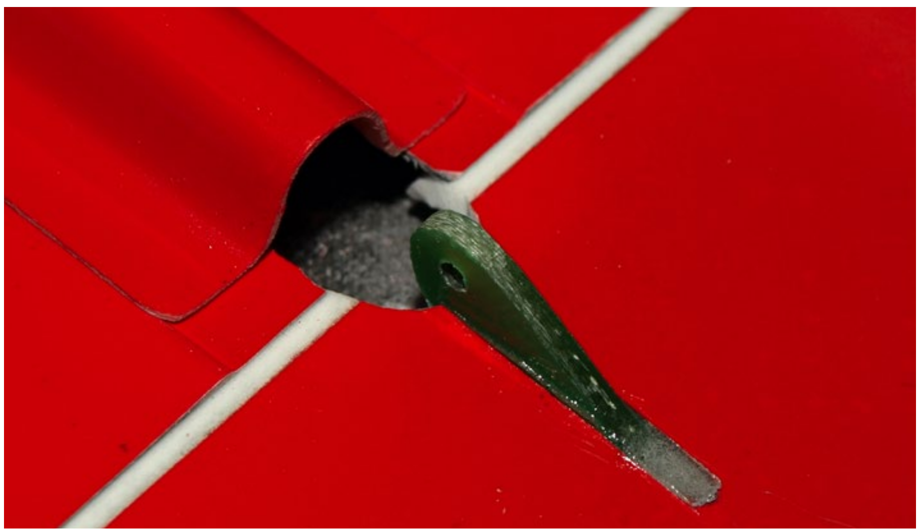
The remainder of the wing work will be familiar to anyone who has done a molded model.

Servo frames are glued in with thickened epoxy, with the servo mounted in the frame after first wrapping with Saran wrap. Be sure to tighten the screws just as you will when securing the servos for flight, do not weight them down during curing, and allow plenty of time for cure. I like to do this step first so they can cure for a few days while I do the rest of the build. A little care during this step will eliminate any telegraphing of the frame footprint through the skin.

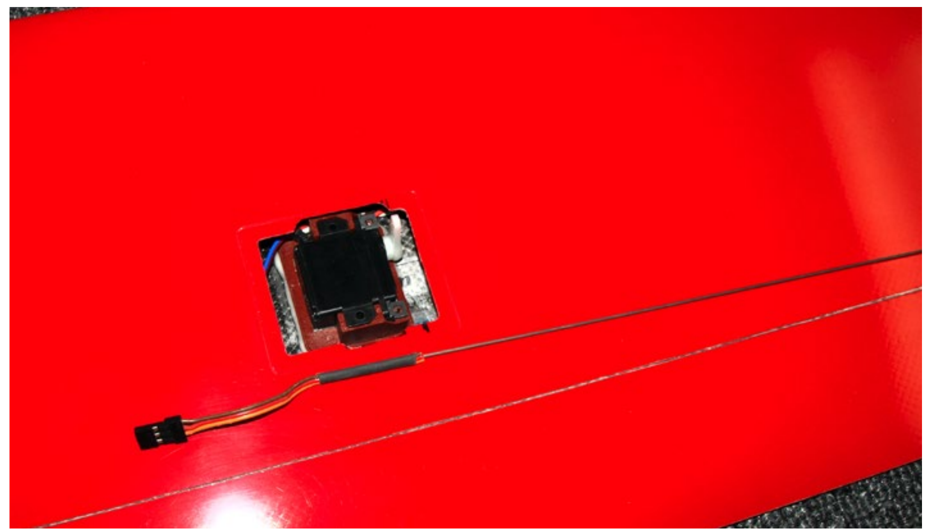


Aileron horn installation. Lower skin and wiper relieved for clevis using sanding drum. Shimmed wire ensures the same geometry for equal movement of both ailerons.

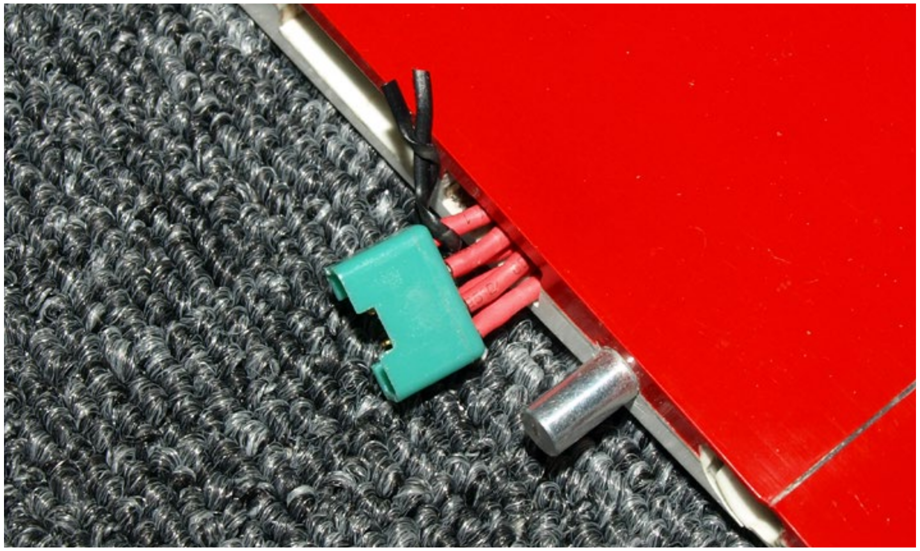
Airtronics 94761 flap servo in frame being glued in place. Servo is screwed in tightly, protected by Saran wrap.



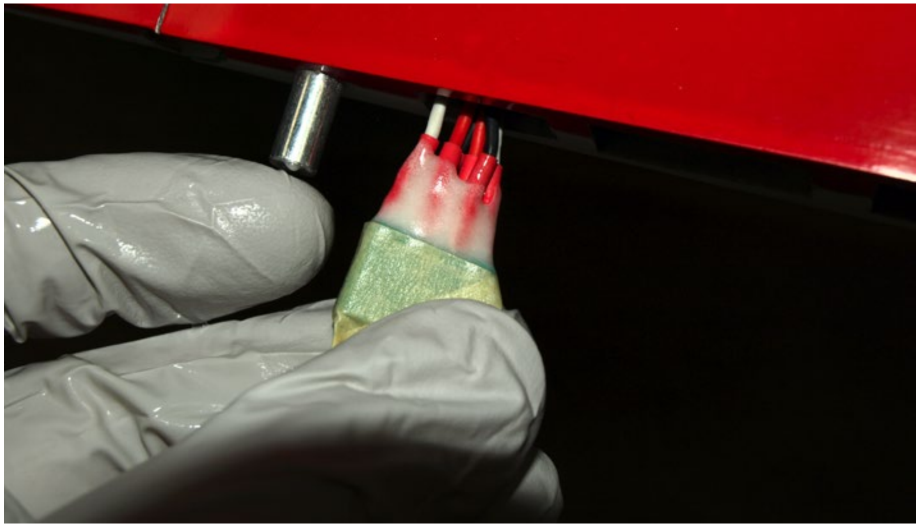
Aileron horn installed.



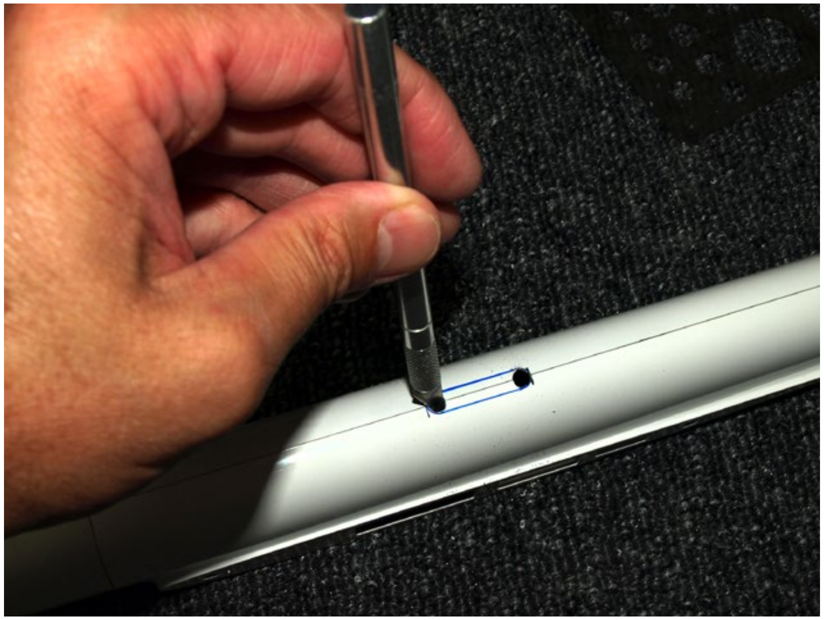
Clip a short servo extension and attach it to music wire with heat shrink tubing for an effective tool for fishing wire harnesses through wings.



Multiplex 6-pin connector. You may wish to pot this into the wing. I chose to leave it loose. There is just enough length in the wire harness to allow disassembly without yanking on the wires.



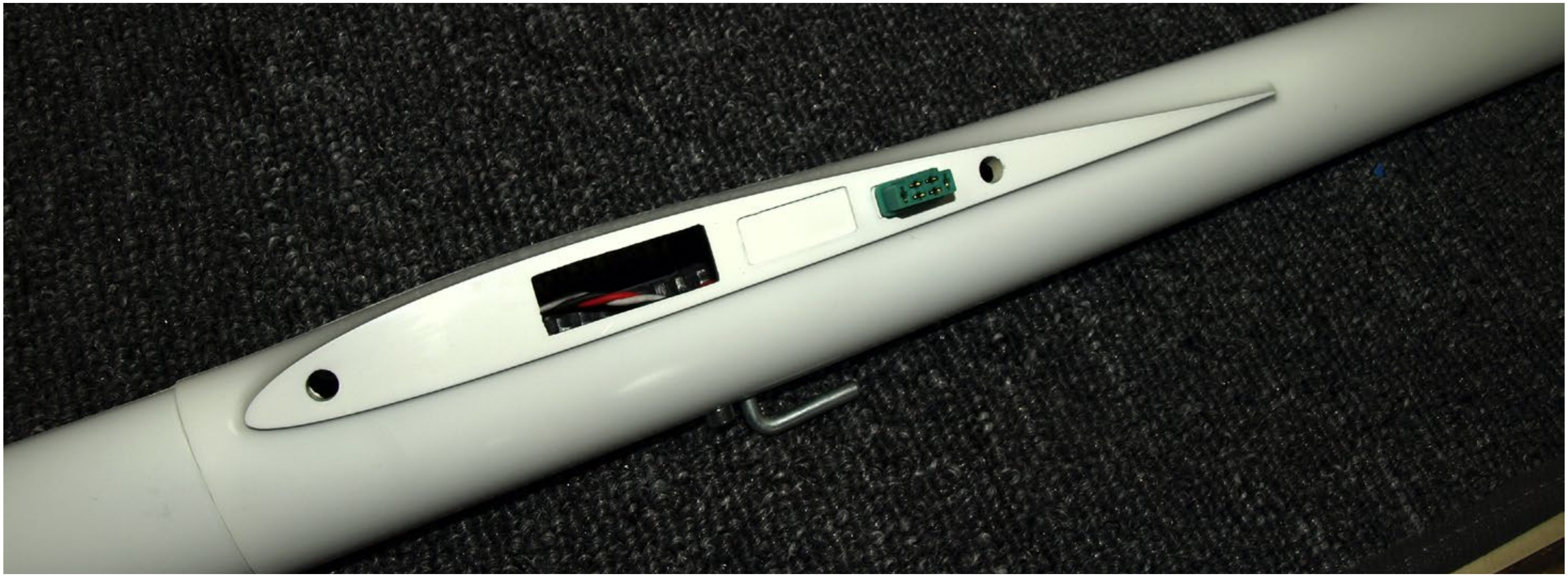
A little alcohol on a glove allows neat smoothing and shaping of thickened epoxy, here to firm up and protect the wires where they'll be handled during assembly/disassembly.



Twisting the knife: the easy way to drill holes in composite skins.

Drill a few more holes then clear it out with a chainsaw file.

A flat file cleans it up the rest of the way.



Fuselage connectors can be glued against molded recesses in the wing root.

Laying out radio gear. Space is very tight so plan ahead for clevis clearance and nose weight.

There really is nothing to do on the tails unless your horns need to be reglued. One of mine was not very secure and pulled loose. It was roughened with a diamond file and reinstalled with thickened epoxy. Be sure to give them a good test and correct the glue joint if you're at all in doubt. You do have to relieve the tailcone for the elevator horns using a small sanding drum.

The supplied fuselage tray is wider than the F3B fuselage so that it can be used with either version. I used a piece of sheet balsa fitted to the nose as a template to reduce the amount of trial trimming of the 1/4" ply tray.

No guidance is provided for locating it. Beware that you may need to leave more space up front for balance weight than you think! At the location shown, my tray left just enough space to balance the model at a neutral CG, and that is with a four cell battery pack (Elite 1500mah NiMH).

Put the tray as far back as you can, allowing just enough room to work with the aft servo pushrod. The servo openings are slightly smaller than needed for the Airtronics 94809 but there is sufficient material to fit two of them.

Height and width inside the nosecone are very limited so plan carefully. I left just a little space at the 'bottom' of the servos and put them on the centerline, resulting in near zero clearance between the clevises and the nosecone.

If using the stock pushrods you will need to support them midway down the tailboom. I used a block of stiff foam rubber cut roughly to the fuselage cross section shape and about an inch long. Holes are easily drilled in it by twisting a metal tube with a rough sawn end by hand.

You could shove the foam block down the boom with a stick and hope the holes stay properly placed and sized to avoid binding the pushrods, but I added aluminum tubes (from the stock used to drill the holes) to the foam, then used the pushrods themselves to guide the assembly into place. The tubes are longer than the foam to help avoid getting epoxy on the pushrods during assembly and added less than a gram.

One O-ring CA'd to one pushrod provides a stop for pushing it into place. Just make sure the O-ring is placed so as to not contact the tube during normal operation.

After masking the accessible area inside the nose I smeared some 5-minute on the foam and in it went. The result is frictionless movement with no slop due to buckling of the bendy pushrods and very little added weight. All this is best done before adding anything else to the fuselage.

My calculations show a possible saving of just about one ounce overall by changing to .07" carbon pushrods in teflon tubes, taking into consideration the reduction in noseweight as well as pushrod weight.

Although you could use the supplied pushrod hardware, I substituted Sullivan 2-56 clevises and threaded rod. I find the Sullivan clevises just fit better and stay tighter on threaded rod than other brands of metal clevises. The popular Hayes plastic clevises may not fit in some of the tight spaces on this model.

After first flights I usually put a drop of black CA on the threads to lock them in place.

<u>Initial Setup</u>

I eyeballed the CG to a point about 4" from the wing LE. RTF weight with stock build and this CG is 88.5 Oz. Note that this is the full carbon version. It is not known how much weight can be saved with the D-tube layup. My initial control surface throws were as follows, measured at surface roots:

Elevator 1/2" up and down.
Rudder 1/2" left and right.
Aileron 3/4" up , 1/2" down.
Flaperon, 25% of aileron movement.
Flaps, about 60-70 degrees max for landing mode.

Launch flap, a conservative 1/2". It will need more to pull hard.

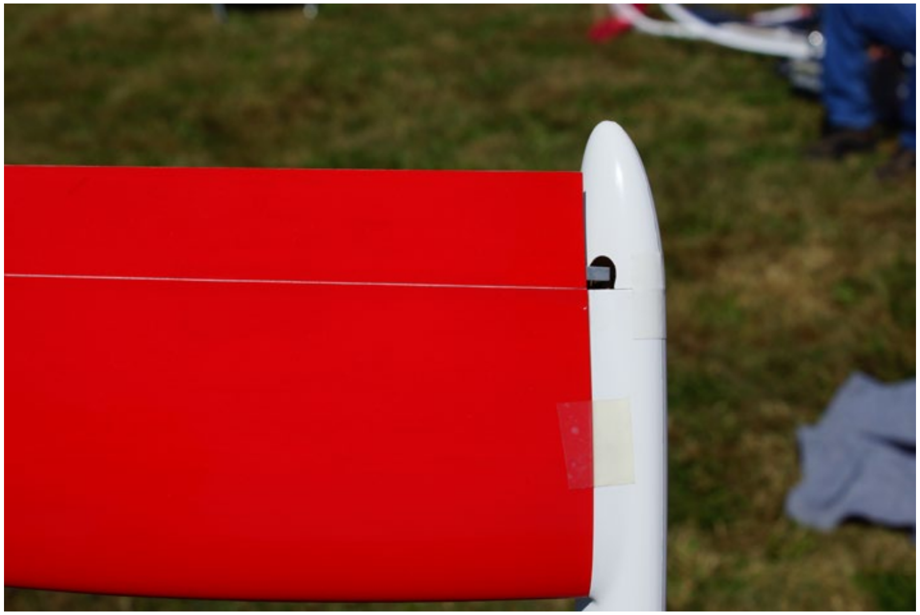
Float, Cruise, and Reflex set to the standard “little bit down, flat on the lower surface, and a little bit up.” Lacking published settings, these will work and things will sort themselves out during the first few outings.

<u>Flying the Toba</u>

Before we did the range check I had been somewhat concerned about the carbon strips and tightly packed gear in the nose. This proved to be unfounded though because we had no issues with range using an Airtronics 92104 receiver which did its job flawlessly as always.

After a quick jog to see how the model felt with some airspeed I did a few hand tosses. Elevator setting was spot on and the throws felt fine. So up the line it went, tracking straight and behaving as it should. The full carbon wing is very stiff, giving a precise feel to the handling. Subsequent flights showed the CG to be neutral. Actual measurement puts this at 4 1/8" from the wing LE, or 105mm.

The obligatory pre-maiden photo. Andy with the newly finished Toba. Notice the slim nose, typical of modern F3B machines.



TOBA DETAILS

Running through a few quick tests I then checked out the handling, stall characteristics, and pushed the limits a little to see how it responded.

With the model pointed away from me I rolled it back and forth a few times quickly to see how the nose tracked – the old roll-around-a-point exercise.

With the above settings and about 40% rudder mixed to aileron input the Toba tracked straight with no adverse yaw.

Roll rate was crisp, just how I like it.

I was happy with the CG so I set elevator trim for float and cruise modes then played around with stalls. The Toba had a lower stall speed than expected and showed no bad habits.

Next was to see how it reacted to a bit of abuse. Starting from a moderately fast speed I cranked it up hard into a steep turn. Toba was right at home, retaining energy nicely through several revolutions. Forcing a high speed stall in that attitude again showed the forgiving handling qualities. The recovery was immediate upon proper pilot input.

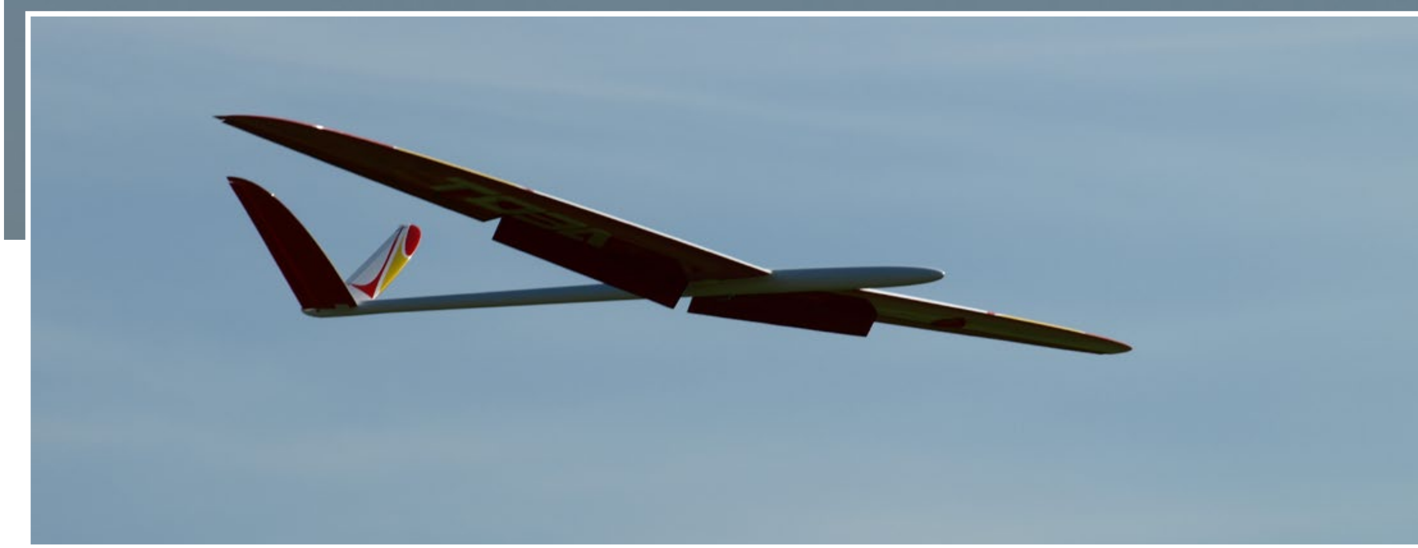
Setting up for a landing, I pulled flaps to check the elevator compensation mix. I'd programmed in a guess which was a nearly linear curve with moderate down elevator travel, and that proved to be a good place to start. As expected, the flaps are very effective with about 60-70 degrees of maximum travel. That is more than enough.

This is a much heavier model than I am used to, with a wing loading of 14 oz/ft^2, yet it floats and goes up in lighter lift than I expected. The crisp handling and wide speed envelope should be an asset for the task soaring it is designed for as well as make for a fun sailplane for big air days at the thermal field or slope.


TOBA


VEZA


VEOT



Conclusion

The Toba was one of the most trouble free, straightforward molded sailplane builds I’ve done. There is nothing tricky or complicated about the build and nothing significant needs to be reworked, though you may choose to use lighter pushrods or your own control horns.

This is a lot of sailplane for the money and I look forward to flying it more!

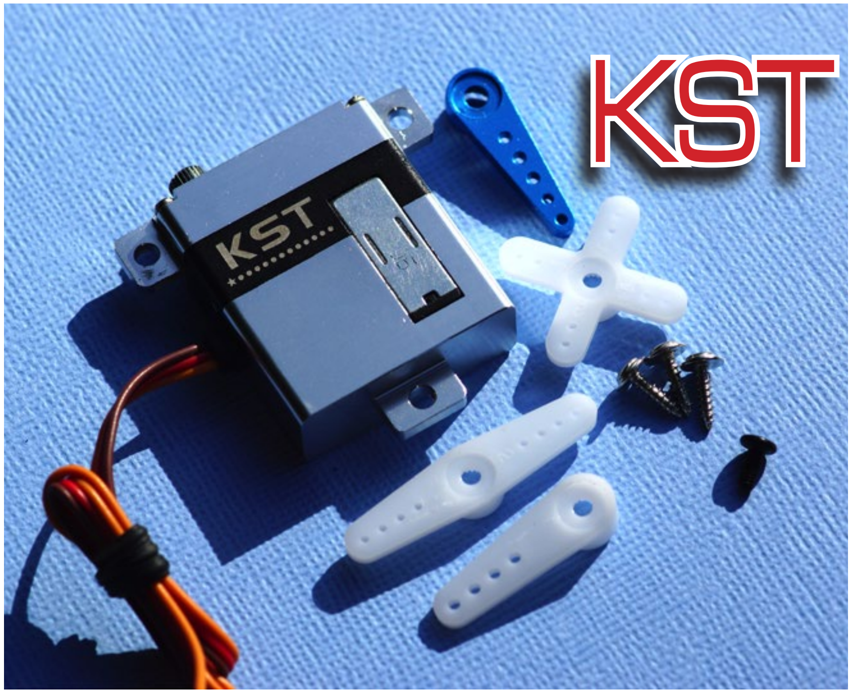
Resources:

OleRC:
<http://www.olerc.com>

Toba:
<http://www.olerc.com/toba-f3b-3-085m.html>

Airtronics:
<http://www.hobbypeople.net/index.php/>

Pushrods, towhook, etc.:
<http://kennedycomposites.com/>



KST DS125MG servo

Bill & Bunny Kuhlman, bsquared@centurytel.net

The KST DS125MG is a thin, metal gear, digital servo. It is designed and configured to be used to drive ailerons and flaps on 2-servo, 4-servo or 6-servo wings.

During our evaluation, many comparisons were made with the Hitec HS-5125MG, a similarly sized servo with which we are extremely familiar, having used them extensively over the last few years.

Our sample was provided by OleRC in Hong Kong <http://www.olerc.com> and arrived in the usual retail cardstock box and was enclosed in a bubble packet. Included with the servo were three plastic servo arms, a blue anodized aluminum arm, three mounting screws and the servo arm set-screw as shown in the title photo.

The body of the DS125MG is primarily machined aluminum. There is a molded plastic portion which sits at the base of the gear train. The case itself is very reminiscent of those produced by Volz for model aircraft use - the flat sides of the motor are flush with the case surface.

All of the gears in this servo are metal. There is no play in the linkage and the sound in operation reflects the sturdiness with which this servo is built. Operation is extremely smooth and the measured travel with signals from 1.00μsec to 2.00μsec was slightly more than 90 degrees.

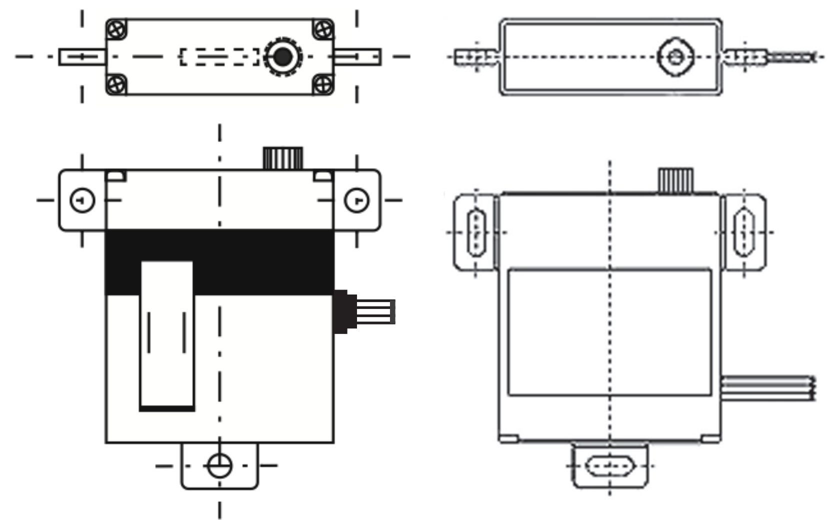
In our testing, centering was consistently right on with no load, and deviations of about 1/8th inch were measured with a load of 48oz.in. (It should be noted that the nylon control arms deflect substantially under this load as well.) With a 5-cell NiMH pack, current draw is approximately 230mA with a load of 24oz.in, and 850mA with a load of 48oz.in. The maximum measured current draw, 1.2A, occurred under full stall conditions.

Because the DS125MG is slightly taller than the HiTEC HS-5125MG and like servos, it may not be able to be used as a direct replacement in most installations. For new installs, wood frames need to be made slightly longer because of the placement of the two “ear” holes. The KST DS125MG is 3gm/0.12oz heavier than the HS-5125 but is rated at about 50% more torque, so will be an advantageous choice in some applications.

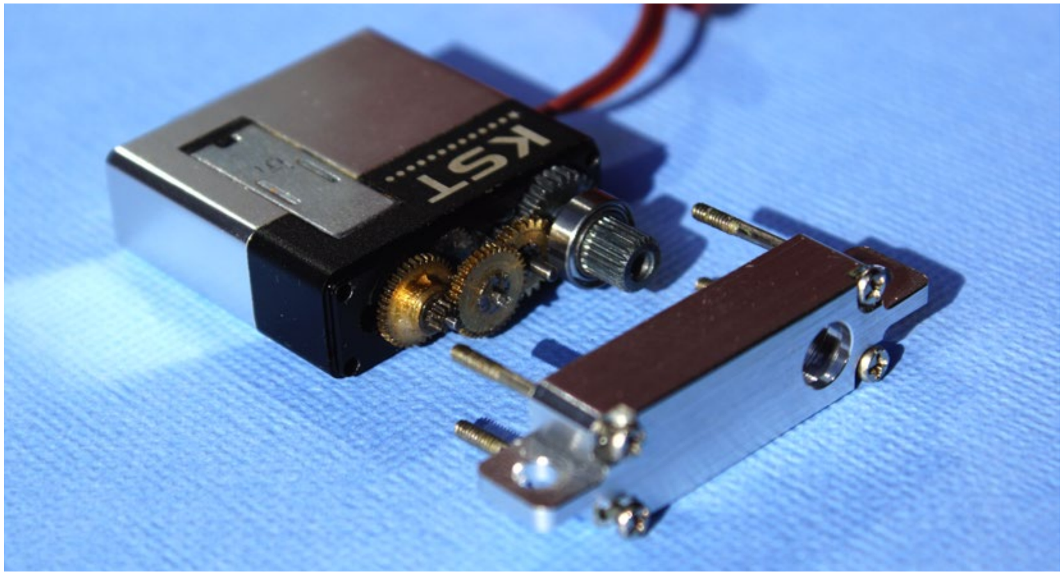
<u>Sources</u>:

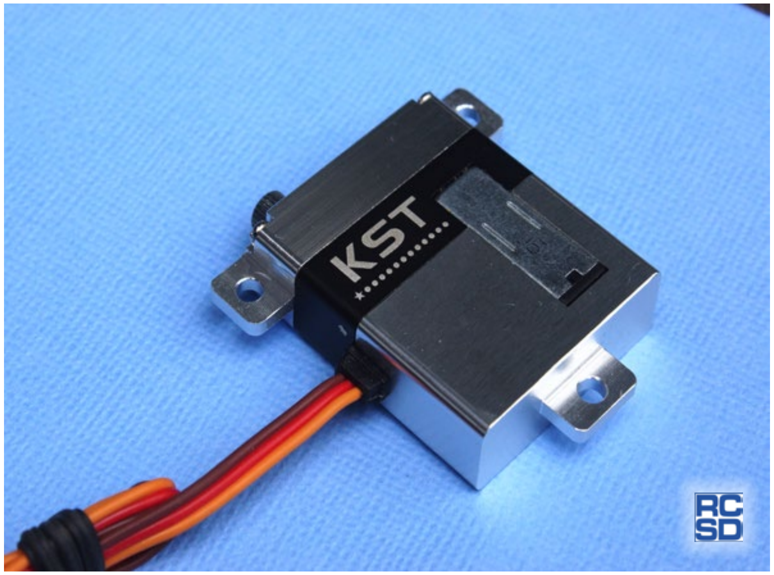
OleRC: <http://www.olerc.com>
KST: <http://www.kstsz.com>

	KST DS125MG	HiTEC HS-5125MG
Dimensions W x T x H	30mm x 10mm x 35.5mm 1.185" x 0.395" x 1.414"	30mm x 10mm x 34mm 1.185" x 0.395" x 1.332"
Rated torque	4.8 Kg.cm, 66.66 oz.in @ 4.8v 5.80 Kg.cm, 80.55 oz.in @ 6.0v	3.0 Kg.cm, 41.7 oz.in @ 4.8V 3.5 Kg.cm, 48.6 oz.in @ 6.0V
Operating speed	0.15 sec/60° @ 4.8V 0.12 sec/60° @ 6.0V	0.17 sec/60° @ 4.8V 0.13 sec/60° @ 6.0V
Case material	Machined aluminum and molded plastic	Molded plastic
Weight	27g, 0.95oz	24g, 0.84oz
Bearings	Dual ball bearing	Dual ball bearing
Gear material	Bronze and steel with steel output shaft	Nylon, steel and bronze with steel output shaft
Retail price	$45.00	$50.00



KST DS125MG HiTEC HS-5125MG





AucklandSoar

Radio Control Soaring Club

SOARFEST 2013

23/24 February 2013 at Matamata

Official Entry Form

** Entries Must be received by **20-02-2013**

Two Payment Options :

1. Snail-mail - with Cheque made out to AucklandSoar Inc. to:

Soarfest

36 Ripon Cres Meadowbank Auckland 1072
Email Aneil Patel (doing Matrix) at : aneilp@orcon.net.nz
or
Ted Bealing at : ted@pl.net once the entry is in the mail.

2. Pay online to the club bank account
National Bank, Onehunga. A/C No 06 0209 0085092 00
Email Aneil Patel at : aneilp@orcon.net.nz or Ted Bealing at : ted@pl.net
once the payment has been made.

Name : ____

NZMAA Number :_______________

Frequency 1 : _______________   Frequency 2 : _______________

Open ☐ (Entry Fee $20.00)   Sportsman ☐ (FREE Entry fee)

Saturday Night BBQ (Details T.B.A) ☐

All entries MUST BE RECEIVED and FEE/S PAID by 20 February 2013
Email entries accepted up until 8 pm on the 20th February – NO Later.

- Entries only accepted on the field if there are no frequency clashes and an available slot is left in the matrix
- Please also provide an Alternative Frequency
  If you cannot change frequencies – you May Not be able to fly.
- Event to be a Hybrid of Premier Duration/F3J.

By entering this contest I agree to abide by the Rules and Regulations as set out by **AucklandSoar Inc,** the Contest Director or the Contest Protest Committee.
I agree to and accept the above conditions.

____
(Signature)

World Soaring Masters 2012

Text by Mike Reagan, mdreagan1@gmail.com
Photos by Mark Nankivil, nankivil@covad.com

Hey guys, I thought you might like a little report on this years masters. If you were not there you missed one of the best contests in a long time. I have been to all four of the Muncie based Masters and flown in the flyoffs twice, which means I have flown 58 rounds, which gives me a great perspective from which to observe the competition. This also means I have been burned and done a little burning myself.

Every kind of condition existed this year from dead calm to 30+ mph winds, rain, cold, you name it. This was a real test of man and machine. Aspires were the plane of choice and in the wind got great launches and penetrated well. However, the few times the wind was not blowing put them at a big disadvantage against the light weight Maxas and super light Explorers. Being at the optimum ballasted weight was crucial to doing well in every round. Being too heavy meant that getting that great save or climbing with the group was almost impossible. Being too light meant you could climb out only to get way down wind with no way to get back!

Having a good caller was also critical, made even harder because of the short time between groups, and the random order made sure you had to get someone different to call almost every round.

Trying to follow other planes down wind led to many land-outs in the beans (zero) and planes landing miles away as pilots pushed the limits of their visibility and underestimated the wind and their planes ability to get back, which was necessary many times to get that max.

I flew twice WELL past my comfort zone, but did get my time! Many low saves were made throughout the contest, never give up was the order of the day.

Ben Clerx and Jim Fricky made great saves during the finals, but the best save was done by Joe. 20 ft. high downwind over the beans, no hope, a puff came through. Zero gain the first few turns but slowly developed into great lift, climbing out to the clouds.

I was timing another flier in this group who made his time easily hooking up right after launch. As Joe said, you must have screwed up to be in that position in the first place. It is much more fun when you make those low saves, though!

The fliers helping each other was amazing. On one of my rounds I grabbed my plane to go fly and when I turned on my transmitter I got the blank screen of death, done, after all that expense and effort. The Horizon boys soon found out and diagnosed the problem as a dead battery. Before I knew what was happening I had a new battery and was up in the next flight group ready to rock and roll! I cannot thank these guy enough for their amazing help and willingness to help a guy when he's down.

On Saturday, trying to finish the last regular rounds, the wind was blowing so hard that the contest was called for safety reasons. These guys were still flying and making maxes! Think about that next time you complain about a little breeze! My group was next up. I switched to my Aspire with the full 32oz of ballast, but was pushed till the next morning.

This worked out great for me as my Maxa is made for super light morning air. I pushed out early as far forward and south as possible as the first group had done well out in that same spot. I stayed as long as possible and slowly drifted back. Others in the group were already starting to land. Now I was out in front of the winches and starting to feel bumps of the very first early morning thermals. Two different circles showed zero gain, but the third showed promise. Working as delicately as possible, I began to drift back over the landing area at about 50ft. It was at this point that I realized I was the only one still in the air. I was literally circling over the guys in my group that were putting their planes away.

Getting burned was just part of the game and it happened to almost every pilot; I think only two did not feel the pain. In another group I was first to launch and the wind was well over 25. With this much wind my flight was pretty much decided within a minute of launch.

The problem was the last to launch was 90 seconds after me. Skip had this happen to him only it was 2 minutes after he launched that the last pilot, after a line break, finally got in the air. Next year this will be addressed with staggered launches as was done in the finals.

This is a very intense contest. Not for the faint of heart. You can come to learn, it may be painful, but you will learn! Bring two planes that are tried and true and won't blow-up with full ballast launching in 30 mph wind. If you want to play, the Masters will be up next year to start the stagger every other year with the World Champs.

Congrats to Joe, flying Maxas, for his well deserved win. He came all the way from New Zealand and his winnings almost payed for his trip!

See you next year!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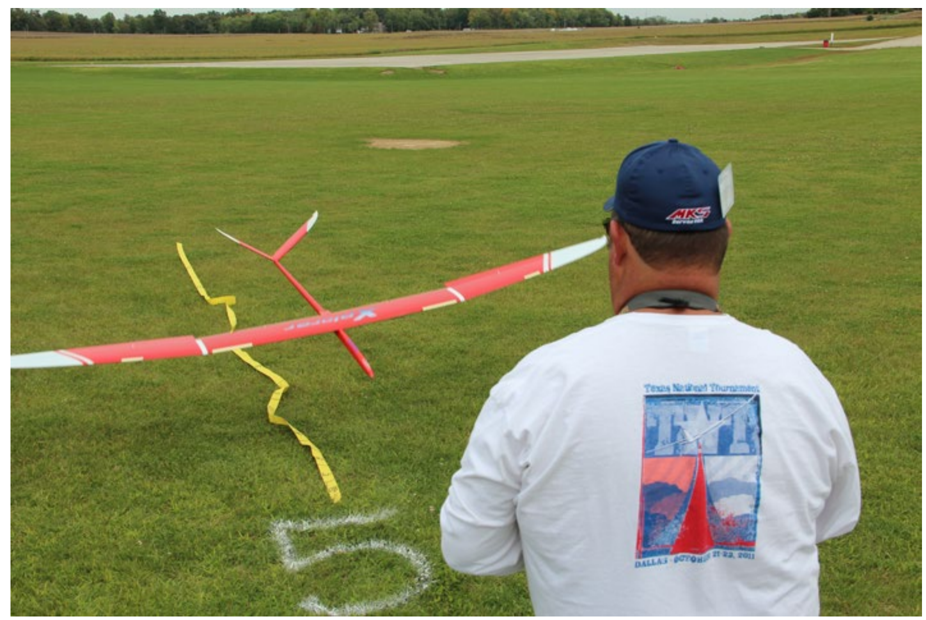


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HORIZON

Scenes from F3J Samba Cup 2012

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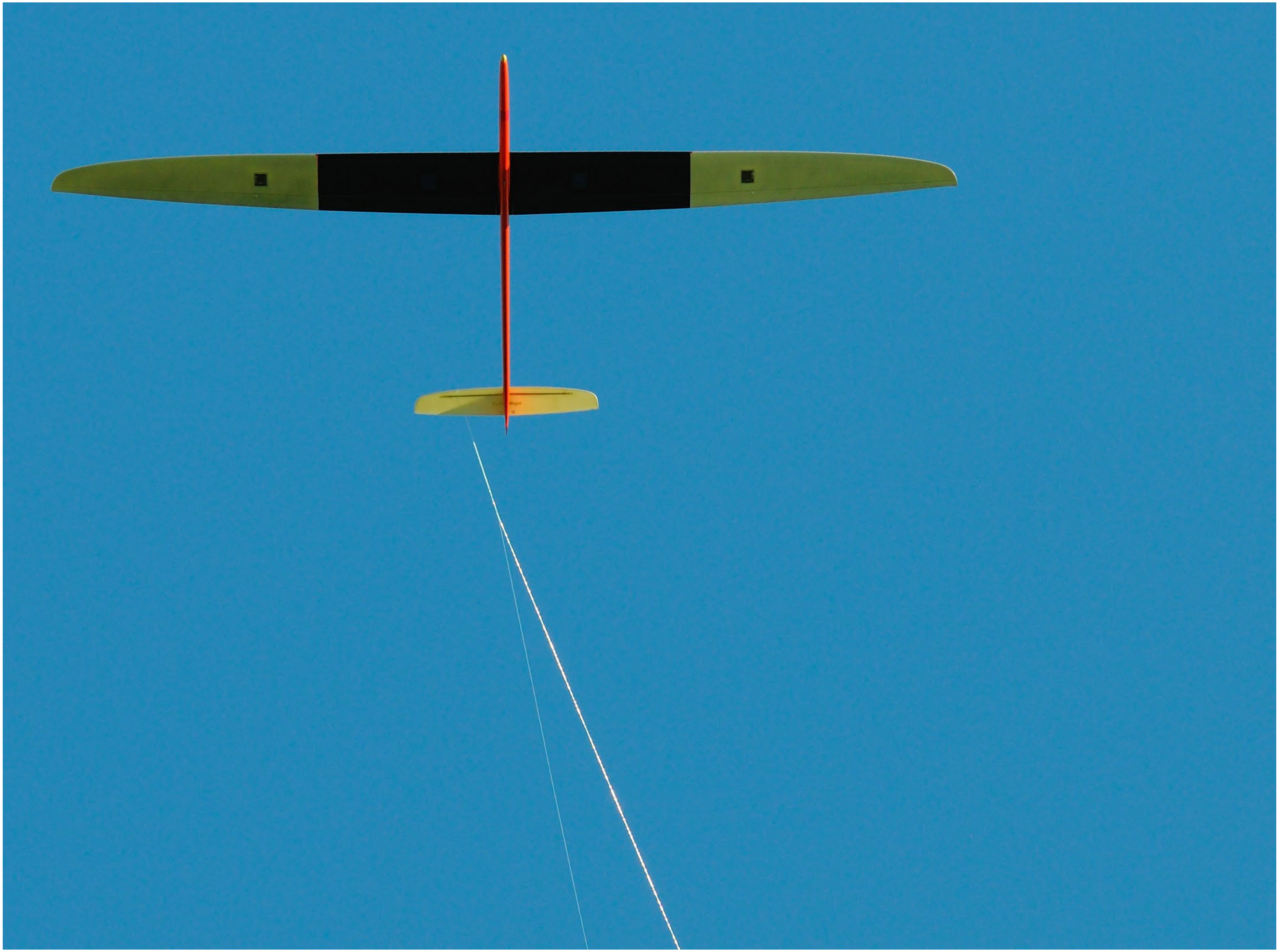


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Inexpensive Model Storage

Stuart Bradley <stuartjaybradley@gmail.com>

I'm sure there are others that are similarly "organisationally challenged" to myself, and hopefully this may provide some assistance with another idea for storing model aircraft, without being too difficult to make or requiring too much in the way of motivation, which can also be commodity in short supply in my garage!

The images pretty much tell the whole story, so there isn't too much to describe.

The foam box comes from the local fruit and veg store, or for me the local fish monger (luckily, this box held plastic wrapped fish). I pretty much just cut out the airfoil shapes with a TLAR approach (That Looks About Right, it wasn't very "right" but didn't matter to me). You may want to put more effort into getting the shape more exact if you're worried about the wing sitting for long periods in there, but none of my planes are special so I wasn't fussed.

One thing to keep in mind is winglets and the like on each wing, so plan out the spacing so all the wings fit in without getting in each other's way.

After that it's just a matter of cutting out each wing slot with a hobby knife, hacksaw blade or whatever other tool is applicable.

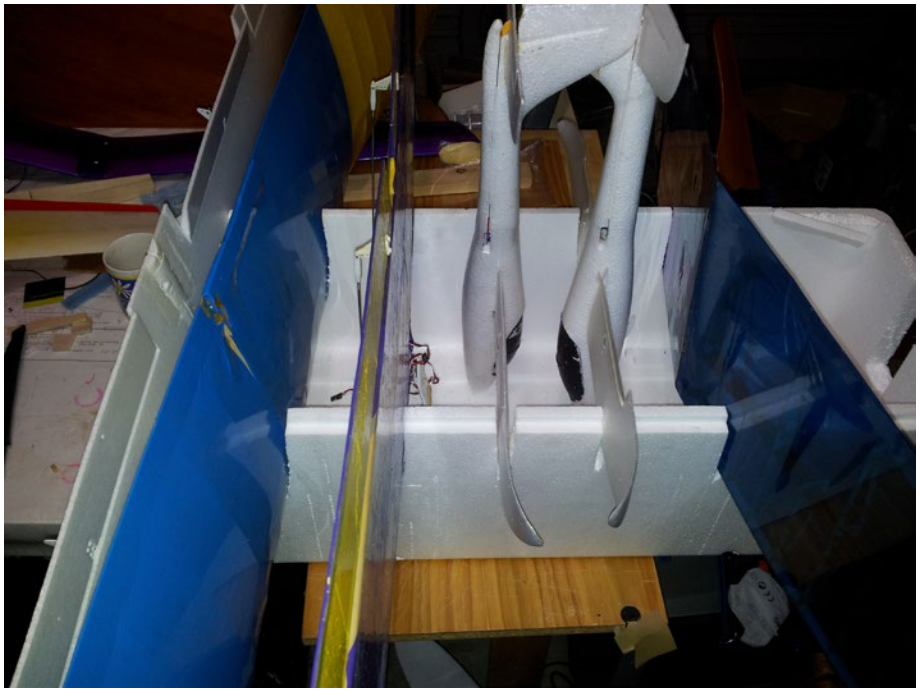
One issue I find is with smaller planes where the wings are permanently fixed, with the box height the nose hits the bottom of the box so they don't fit as exact as they could. Not a big problem, and still better than having them laying around the garage taking up more space than I had available.

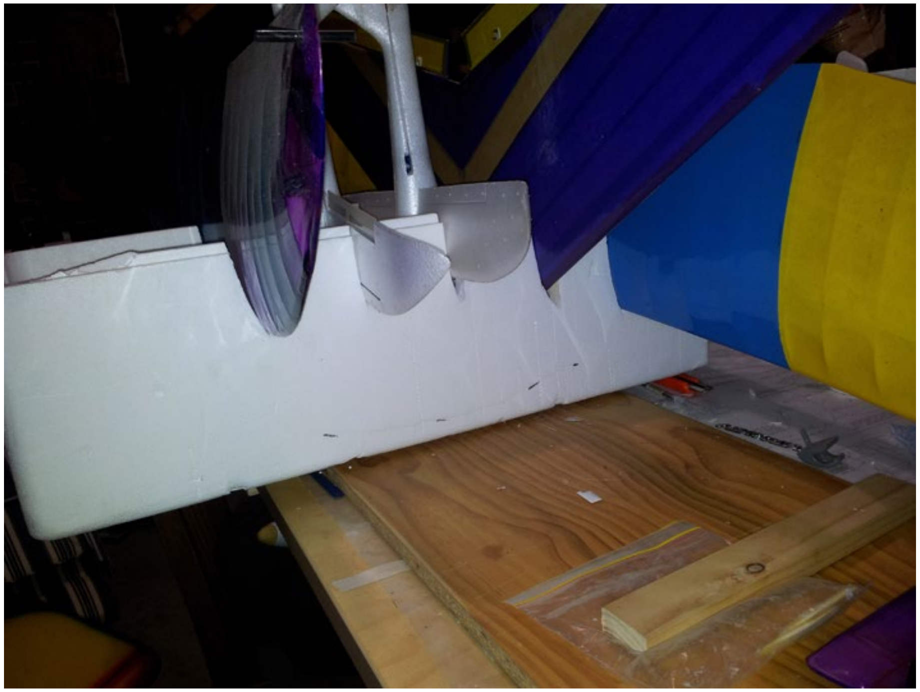
In addition to the space and security benefits, I think the fact that the wings are stored on the leading edge is a better option,which should stop the warping that was possible with them laying around or propped in the corner.

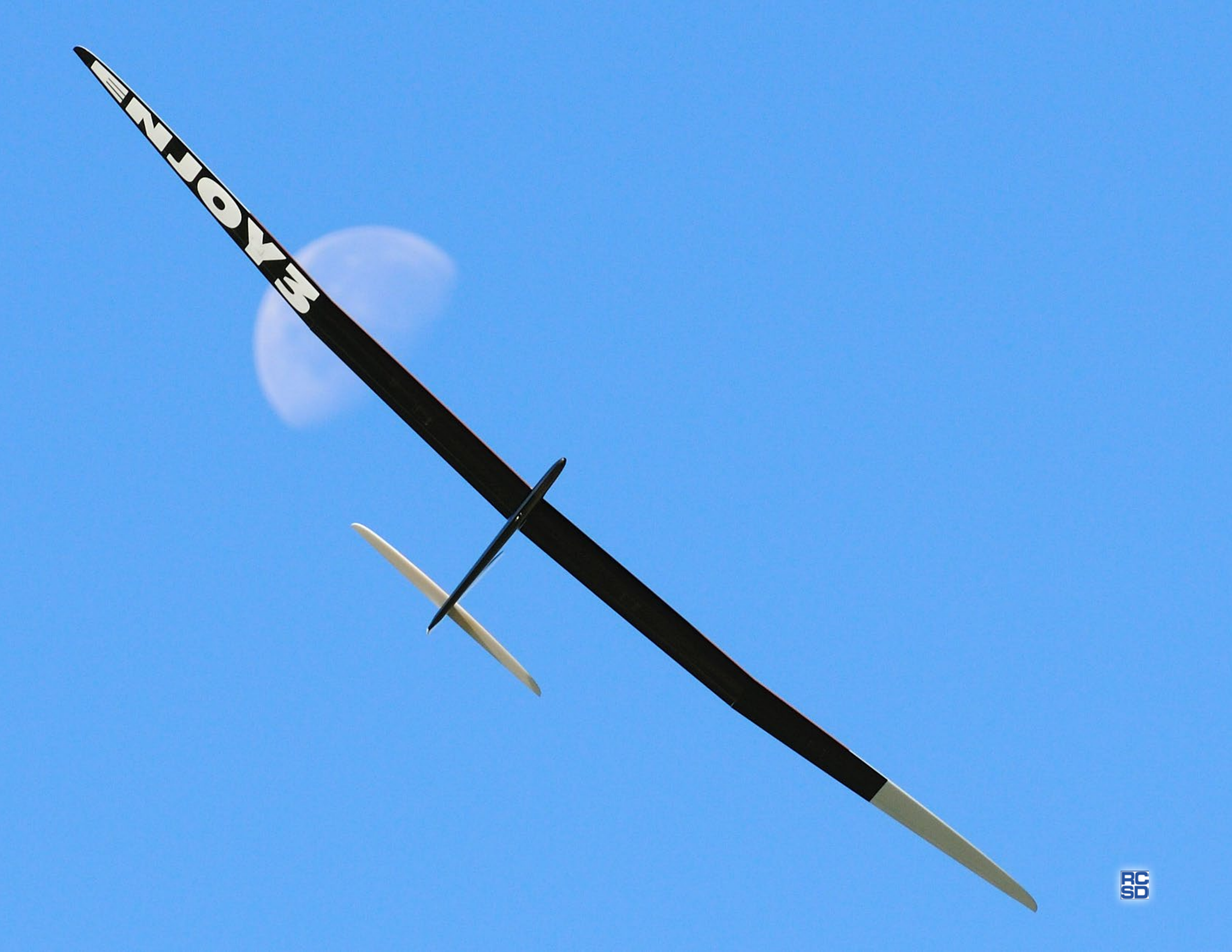
I'm sure there are a lot better storage solutions out there, but for me this worked well. It's cheap (no cost really), fast and easy to make, and effective for its intended purpose.

As well as this, its transportable and useful if taking lots of planes on a trip.

Hopefully this may be helpful to someone else who is organisationally challenged like myself and could use a simple method to store their models.



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