# Seether

A PLDaniels Design

August 17, 2006

# Contents

# Part I

# Introduction


The Seether was born out of the desire to have an enjoyable, easy to fly pusher wing type plane that was simple to build, made of balsa and large enough to carry standard gear and also to be visible from a reasonable distance.

The initial prototype testing caused a great deal of anguish and trouble due to factors not related to the airframe. Initially the CG was poorly chosen and twice there after electronics failures caused the Seether to finally acquire its name as quite literally I was seething while picking up the pieces for a third time in as many days. Finally on the fourth day everything came together well and the Seether was a joy to fly. At speed the large wing area and twin vertical stabs hold the Seether straight down the line, with the throttle off the Seether behaves like a sedate wing with a large drag profile and low wing loading meaning it can come in for very gentle landings.

The inclusion of a separate elevator, rather than relying on flaperons gives the Seether an added level of pitch stability without detracting from the ability to pull aggressive moves.

I sincerely hope that you find the Seether as enjoyable to build and fly as I have.

# Part II

# Building

# Chapter 1

# Preparation

To make building the *Seether* as efficient as possible, it's recommended you have the following resources and tools at your disposal

- Workbench of at least 1500 x 600 (5 x 2') mm in size (for general building)
- White-glue (PVA, Aquahere, Weldbond etc). CA can be used but isn't required.
- Epoxy (may be supplanted by Polyurethane/Gorilla glue etc)
- Balsa Plane (not essential but makes building a lot more pleasant)
- Xacto type No.11 blade knife
- Assortment of clamps and pegs
- Weights (sandbags, old Gel-cells, metal blocks)
- Straight-edge rule
- Patience (yes, seriously, patience, your plane will turn out a lot nicer if you don't rush it )

Throughout this manual there will be references to using various tools to do certain tasks, you are not obliged to follow strictly what is done in the manual, everyone has their own preferred methods. Gluing of items is additionally a rather subjective affair, the selection of glues in this manual is based on anticipated loads and stresses that a particular join may be required to take, if you feel that you prefer another selection of glue then certainly go ahead, it is after all a personal judgment call. It is of my personal opinion that using PVA/White-glue such as Weldbond or Aliphatic resin will result in a much better model than using CA, not to mention the health problems that CA can potentially induce.

Some people may laugh at the requirement of patience, the truth is that after years of building, it would appear that patience can actually speed up a build and result in a better quality finished item, this is because there will be less accidents due to rushing an item (CA can be a wonderful glue that bonds fast but it can commit mistakes equally as quickly).

Examine your kit and make sure that all the parts are included and none of the items are missing from the laser cut out sheets. Also check that none of the parts in the kit are broken. It helps at times if you mark off the parts on the plan as this gives your mind a chance to associate where things go.

All dimensions and weights are specified in metric.

# Chapter 2

# Booms, Spike and Horizontal Stabilizer

The tail booms and the nose spike do not require a lot of work but they do need to be prepared beforehand so as to facilitate faster building later.

## 2.1 Tail booms

- Take the two parts of each tail boom and glue together while using a piece of scrap wood from the horizontal stabilizer sheet to ensure the correct gap between the two segments is maintained.
- Set aside the tail booms under weights until they are dry
- (See figures 2.1, 2.2 and 2.3)

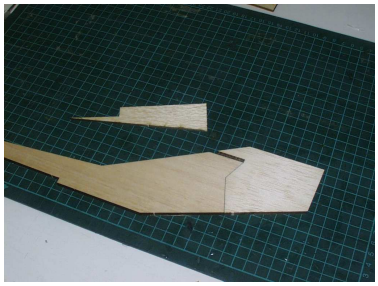


Figure 2.1: Two boom segments joined

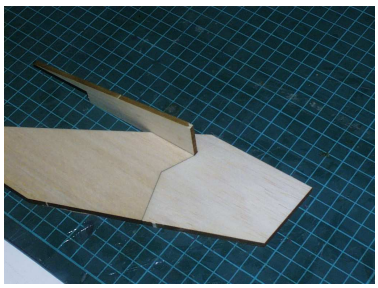


Figure 2.2: Scrap balsa to set gap

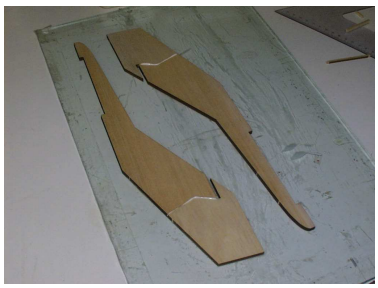


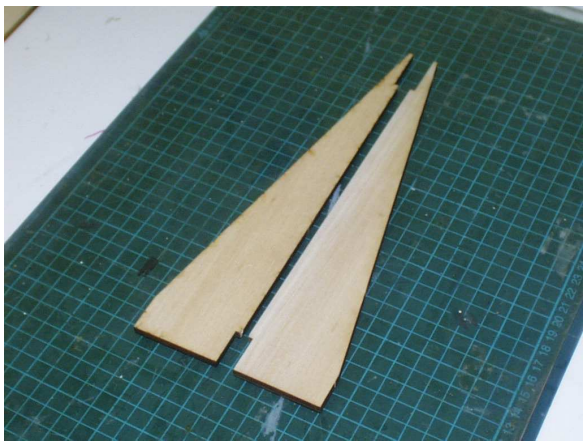
Figure 2.3: Dry on flat surface

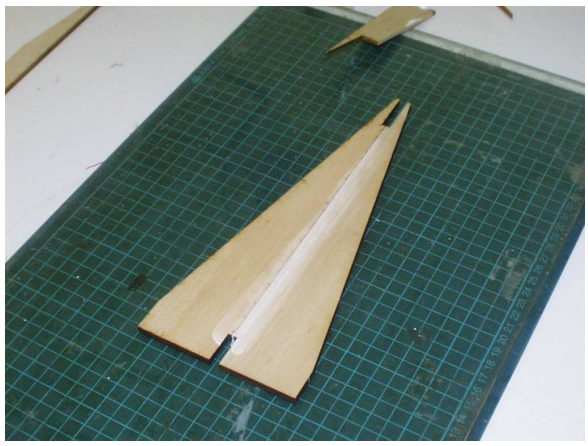
## 2.2 Nose Spike

- Join the two halves of the nose spike together and set aside to dry

## 2.3 Horizontal Stabilizer

- Join together the two parts of the horizontal stabilizer (stab and elevator) and use masking tape to hold them together on one side, the masking tape side will become the top side of the stab. (See figures 2.4 and 2.5)





- Turn over the stab and proceed to razor plane (or sand) down the elevator until its TE is no more than 1mm thick. (See figures 2.6 and 2.7)

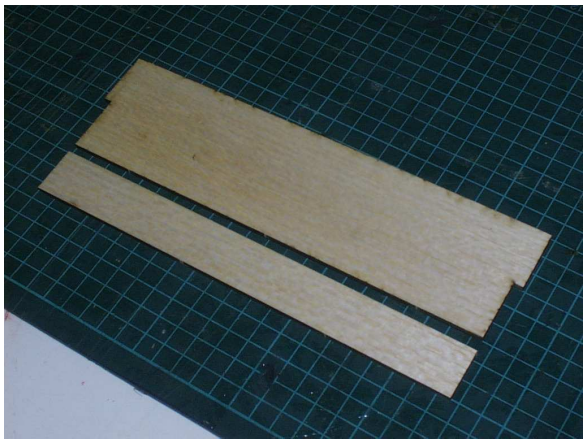


Figure 2.4: Two sections of the h-stab

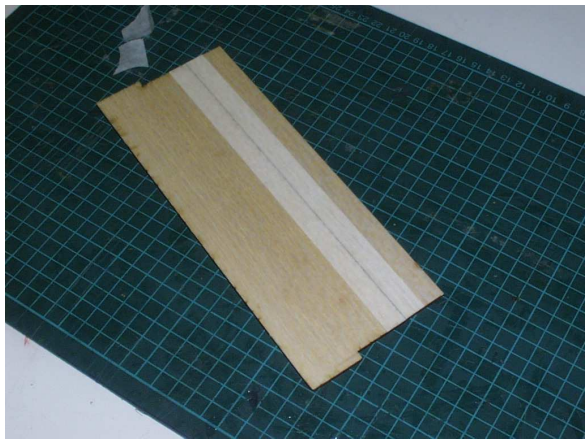


Figure 2.5: H-stab joined with masking-tape.

Figure 2.6: Shaping the elevator

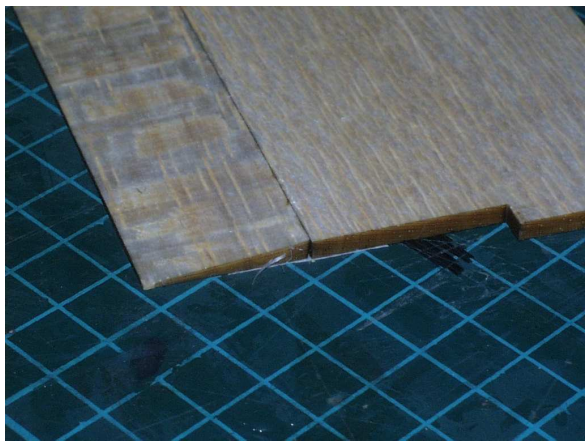


Figure 2.7: Finished elevator

- Fold back the elevator (Figure 2.8)
- Razor plane (or sand) a 45 degree bevel on the elevator where it will hinge onto the stab (Figures 2.9 and 2.10)

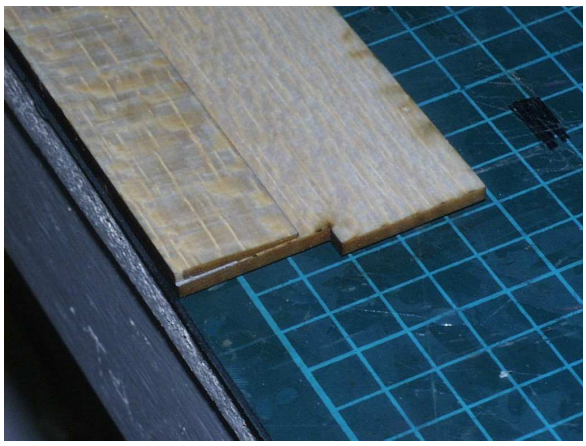


Figure 2.8: Elevator folded back

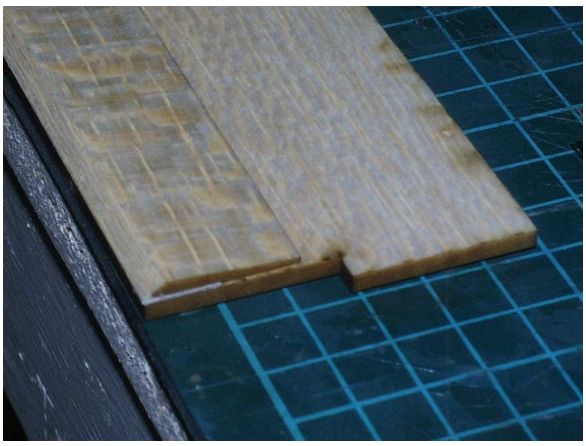


Figure 2.9: Beveled elevator

- Shape the leading edge of the horizontal stab to an egg-nose profile ( Figure 2.11 )

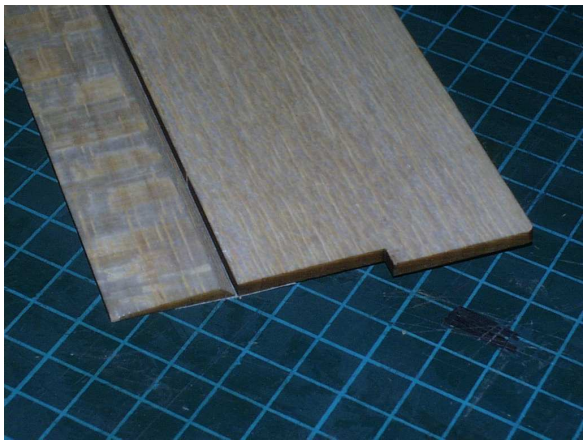


Figure 2.10: Finished elevator

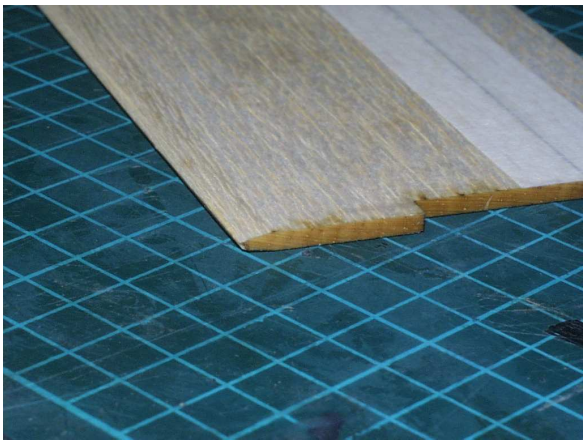


Figure 2.11: Rounded nose

# Chapter 3

# Wing

With the *Seether*, everything is centered around the wing, the wing is the major portion of the entire plane. How well you build the wing will directly dictate the performance of your *Seether* as well as its limits, a poorly built wing could result in a destructive failure costing you a lot more than just the price of the *Seether* kit.

The Seether wing is composed of two distinct halves that are comprised of 3 pieces, front half, rear half and wing tip.

## 3.1 Creating the wing half

- Join the front and rear halves of the wing together with a high flex, high lap-shear strength glue such as PVA/White-glue. CA is not highly recommended due to its brittle nature.
- Do NOT attach the wing-tip yet.
- Weigh down and clamp the two halves so that the join between them does not open up. (See figure 3.1)
- Do not worry if the aileron detaches from the rear-half of the wing panel, you can just tape it back on with masking tape or retain it in a safe location.
- You may find it useful to use the tail boom piece to help hold the two halves together while drying . (See figure 3.2)

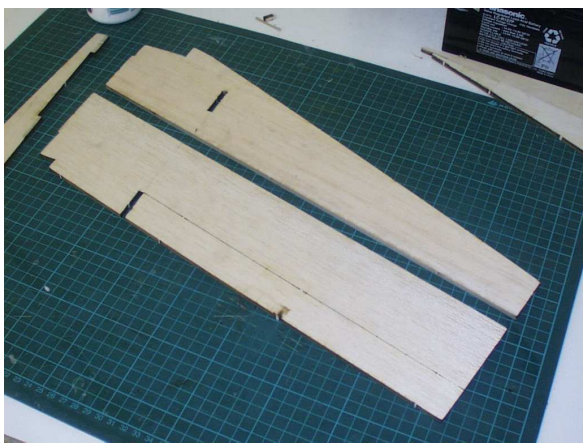


Figure 3.1: Joining two wing portions


Figure 3.2: Using the tail boom to assist

## 3.2 Shaping the wing

Once the wing half has been glued, we can proceed to create an airfoil section for it. While this airfoil section is not super critical it does always help the performance if you can do a smooth and consistent job of it.

- Mark off a line 25mm (1”) from the leading edge of the wing (See figure 3.3).
- Mark off a line 50mm (2”) from the trailing edge of the wing.
- Shave or sand down the leading edge portion to approximately 2mm (1/10”) from the bottom of the wing. (See figure 3.4).
- Shave or sand down the trailing edge portion to approximately 1mm (1/20”) from the bottom of the wing (See figure **??**).
- Sand down the wing to produce a smooth transition between the LE, center and TE portions (See figures 3.6).

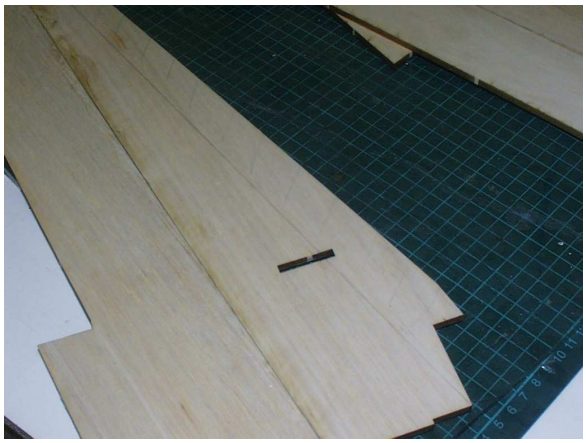


Figure 3.3: Marking off the LE section

Figure 3.4: LE section shaved down

Figure 3.5: TE section shaved down

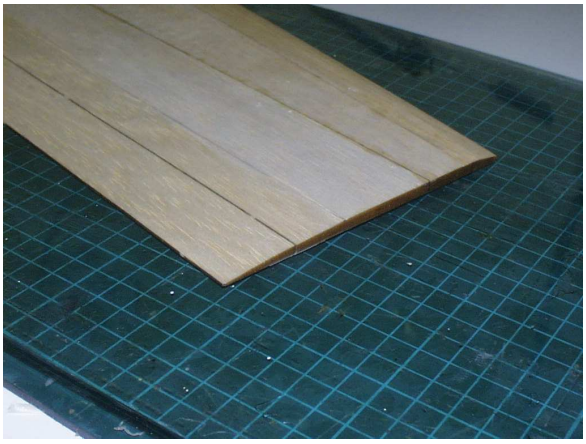


Figure 3.6: LE and TE sections shaved

## 3.3 Attaching the wing tip

Now that the primary part of the wing is shaped, we can attach the wing tip. By applying the wingtip on after the primary shaping we avoided having use the hand planer across the grain on the tip (which would cause it to typically become very messy).

- Place but do not glue the wing tip on the edge of the wing and examine the fit and lie of the tip. (See figure 3.7)
- Mark the area that will need to be removed with a pen or score line (See figure 3.8)
- Shape the wing tip down to match the profile of the main wing
- If required, place the edge of the wing over the edge of your workbench and sand to a flat finish. (See figure 3.9)
  - Be careful when doing this and periodically check the fit with the wingtip to ensure they line up correctly.
- Glue the wing tip to the main wing (See figure 3.10)

Figure 3.7: Dry fit wingtip

Figure 3.8: Mark off profile with pen

Figure 3.9: Sanded wing edge

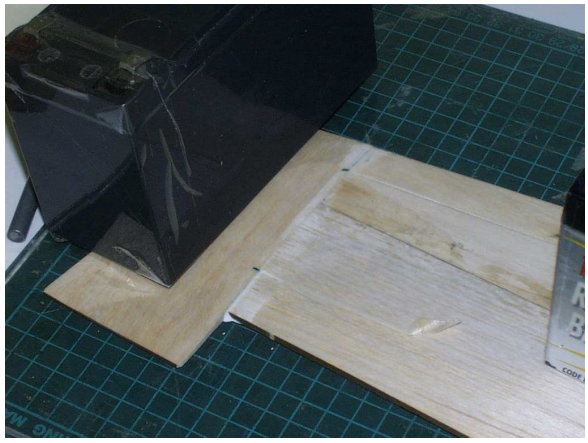


Figure 3.10: Gluing of the wingtip

## 3.4 Joining wing halves

- If required, lightly sand the centers of the wing half segments to ensure a good match
- Bring the two wing segments together and glue
- insert the nose spike that was created earlier and glue

(See figures 3.12 and 3.11)

Figure 3.11: Wing halves set for gluing

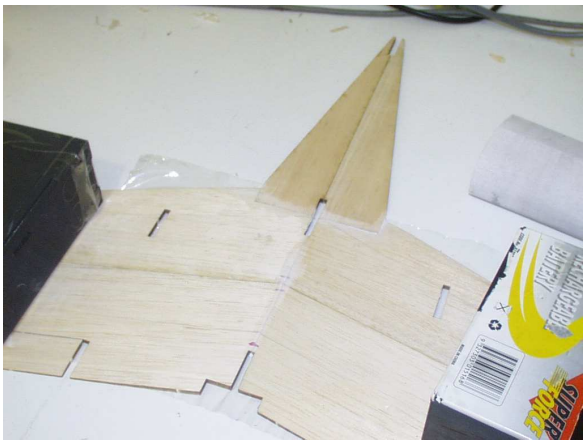


Figure 3.12: Nose spike glued in

- Glue on wing / nose-spike gussets
- When the wing join is dry, turn over the wing
- Insert main under-body spine (Figure 3.13)
- Add two 10mm (3/8”) square or triangular stock reinforcements (Figure 3.14)


Figure 3.13: Under-body spine glued on


Figure 3.14: Reinforcement stock added

## 3.5 Wing Sanding, Reinforcement and Covering

The wing is now ready to have the finishing stages done. It is optional but recommended that you apply the carbon fiber ribbon tow to the underside of the wing after sanding is complete.

The choice of covering is left to the builder but we find that laminating film makes for an excellent low cost covering material that is exceptionally tough.

# Chapter 4

# Fuselage

- Glue and secure the rear firewall / former to the wing. This former should be aligned to the edge of the reinforcement spine. (Figure 4.1)
- Perform a mock setup of the fuselage sides, battery and F2 with the nose of the fuselage sides lined up to the nose of the spike. (Figure 4.2)

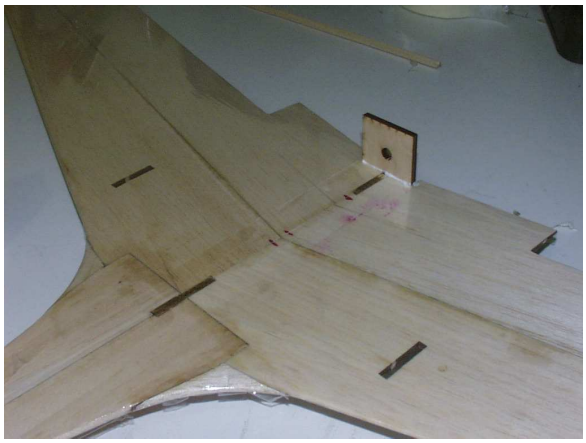


Figure 4.1: Rear firewall glued

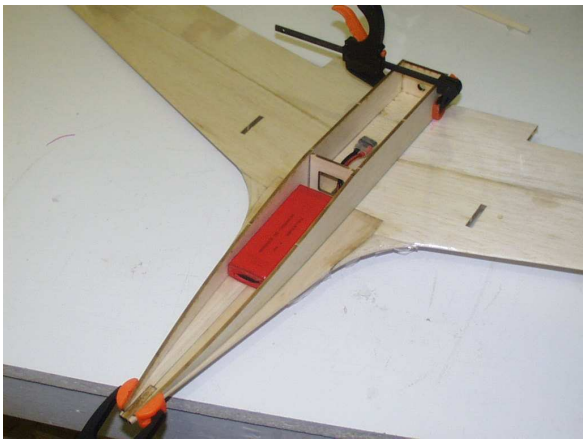


Figure 4.2: Mock fuselage setup

- Using a very sharp knife, score along the covering on the wing (Figure 4.3)
- Remove the covering from the wing where the fuselage will rest
- Glue down the two reinforcement sheets, butted against the rear firewall along with the fuselage sides (Figure 4.4)

Figure 4.3: Score and remove excess covering

Figure 4.4: Reinforcement sheets glued

- Glue in magnet holder that was prepared earlier (Figure 4.5)
- Glue in F1 against at the end of the reinforcement plates (Figure 4.6)

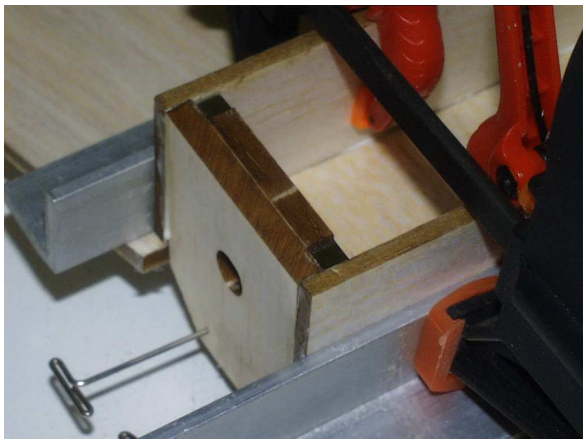


Figure 4.5: Sides and magnet holder glued

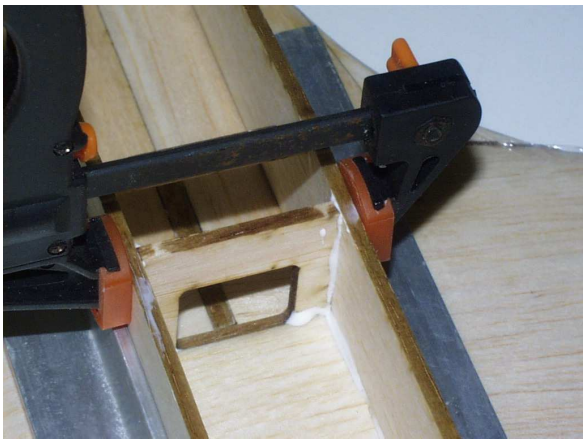


Figure 4.6: F1 glued in

- Glue in both F1 reinforcement braces (Figure 4.7)
- Clamp fuselage sides to the nose point and run a bead of glue from F1 to the nose on both sides
- Clean up glue and clamp fuselage sides down onto the nose spike (Figure 4.8)

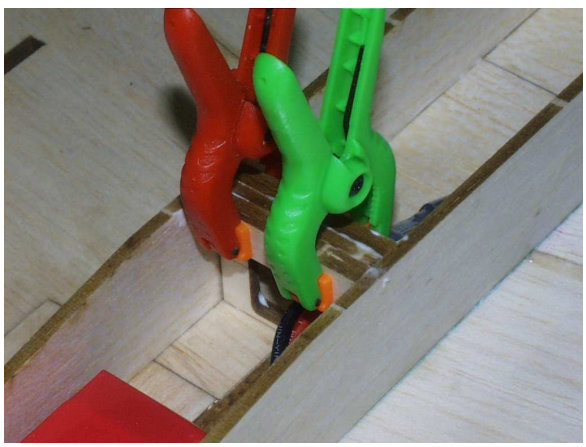


Figure 4.7: Two F1 reinforcements

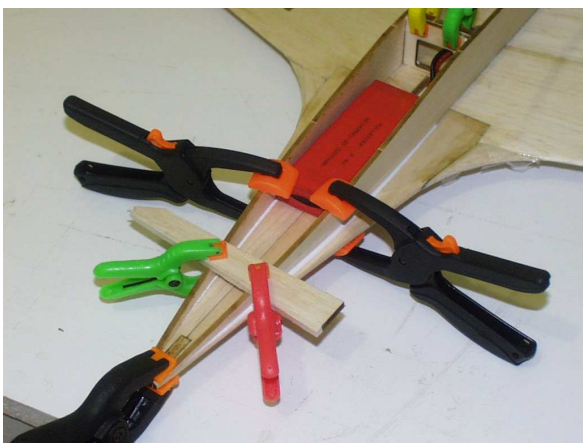


Figure 4.8: Fuselage sides glued down

## 4.1 Fuselage hatch

- The hatch is made of four (4) pieces.
  - 1 of Leading, curved deck
  - 1 of Rear, rectangular deck
  - 2 of Angled joiners
  - (See figure 4.9)
- Glue the two angled joiners into the rear rectangular deck slots and wait for the glue to dry
- Mount the rear deck+joiners onto the fuselage with tape
- Apply glue to the leading, curved deck slots
- Join and tape down the leading deck
- Leave to dry.

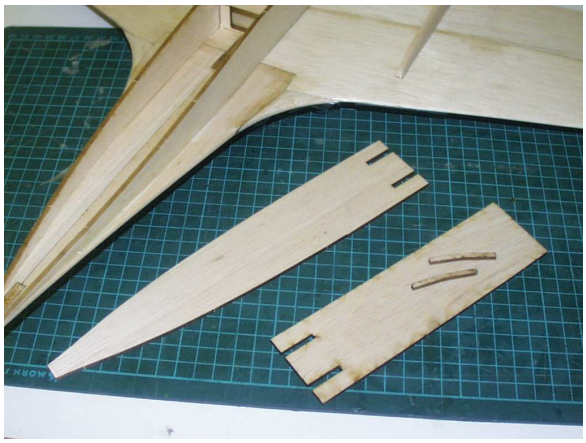


Figure 4.9: Four parts of the deck

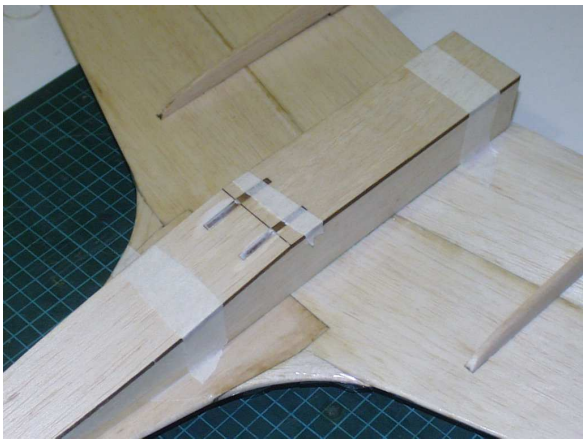


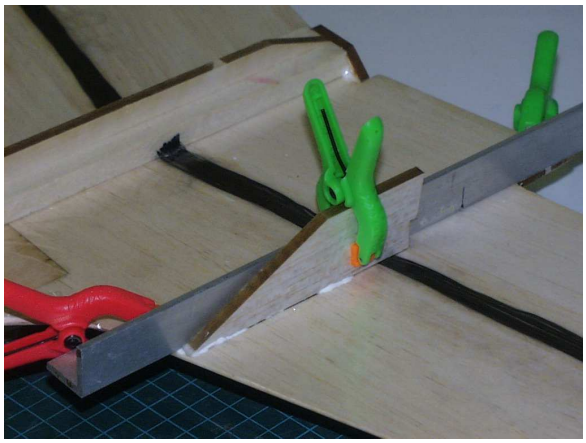
Figure 4.10: Completed deck, drying

# Chapter 5

# Finishing up

## 5.1 Wing skids

- For the protection of the wing aileron/flaperon servos, there are two wing-skids that must be applied to the underside of the wing.
- Make sure when you apply these skids that you remove the covering from underneath.
- The skids should align with the leading edge of the wing and the tail boom slots.



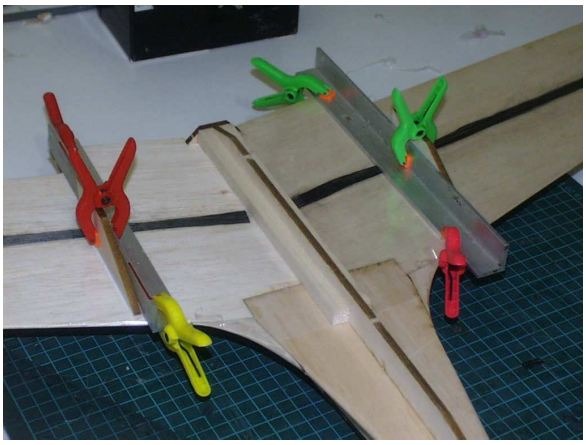


Figure 5.1: Applying wing skids.

## 5.2 Fitting the tail booms

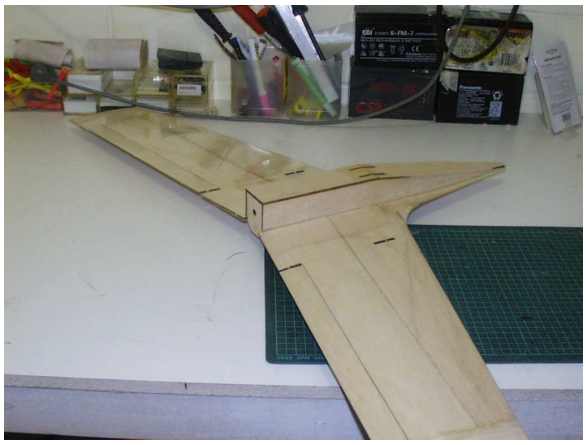


Figure 5.2: Before inserting booms

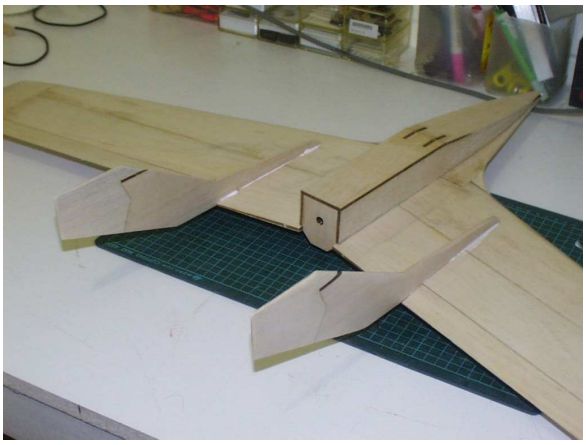


Figure 5.3: Booms glued in

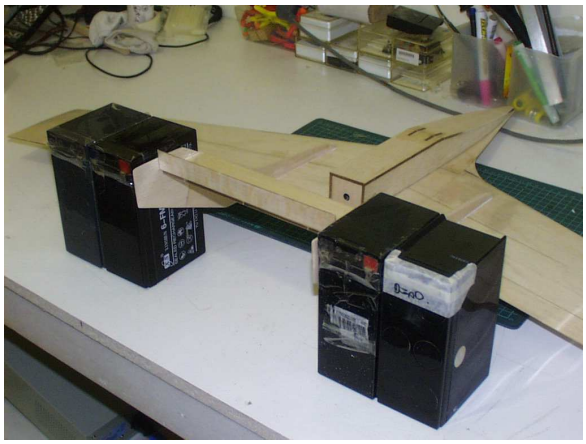


Figure 5.4: H-stab glued in

Figure 5.5: Booms and hstab finished

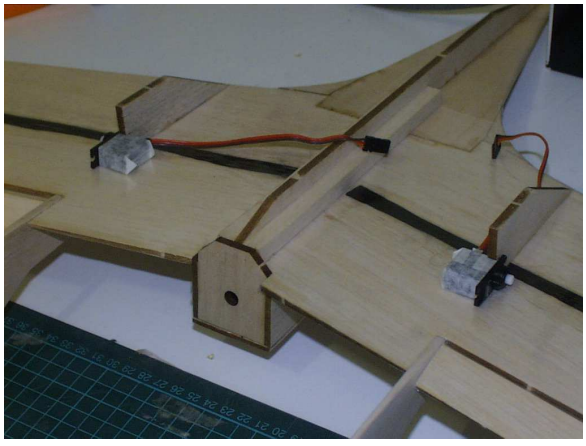


Figure 5.6: Aileron servos

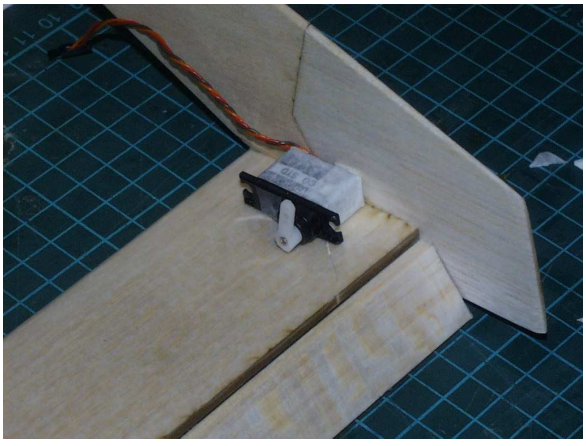


Figure 5.7: Elevator servo

Figure 5.8: Cable routing

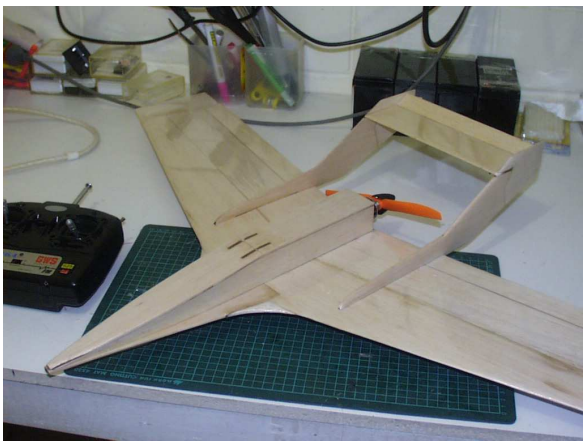


Figure 5.9: Finished Seether

# Chapter 6

# Flying

## 6.1 Control surface setup

### 6.1.1 Elevator

If you have the ability on the transmitter, it's recommended to have either dual-rates or expo-rates setup for the Seether elevator. During normal flight there is very little movement required, however on landing approach with power off it's often useful to have a lot more elevator movement to facilitate washing off speed.

In-flight movement range is +/-3mm (1/8") of deflection (yes, a very small amount).

Landing movement range is +/-6mm (1/4")

### 6.1.2 Ailerons

As with the elevator, the ailerons do not need a lot of deflection. In fact, with excessive deflection you risk adverse stability issues including spontaneously snaps and flat spins.

Medium Aileron deflection: +/-10mm (3/8")

### 6.1.3 Flaps

If you've decided to use a two servo aileron setup you can program your TX to provide a flap/reflex facility which can be useful for landing approaches.

## 6.2 Battery Selection

### 6.2.1 NiMH

The Seether was designed around a 2S2200mA lipo pack, however a suitable NiMH pack can be used in its place. Typically for the same size, you can obtain a 7 cell, 2/3AA flat pack which should fit in the same place and weigh about the same. With current NiMH technology you can find cells between 700 and 800mA capacity.

### 6.2.2 Li-poly

Anything between a 2S1500-12C / 2S2200-12C and upwards can be used. The Seether is designed around a pack size of roughly 100mm x 40mm x 20mm.

Despite having a lower nominal voltage of 7.4V versus the 8.4V of a 7 cell NiMH pack the lipo can actually end up having a higher real voltage during the flight due to the internal resistance differences. The great thing about using a lipo pack is that the AUW for the plane can be lower for the same flight times or you can choose to keep the same AUW and have longer flight times.

## 6.3 Prop selection

### 6.3.1 Brushless 2205, 2000kV Outrunner

A typical 2205 outrunner on 2S will be able to cope with a prop up to the maximum 8” diameter that the Seether can accommodate. Naturally it’s recommended that you consult the documentation supplied with your motor to select the most appropriate prop. GWS-SF7060 and HD8040 props have been found to work well for 2205 class motors .

Ideal prop selection will vary dramatically based on your battery selection and prevailing atmospheric conditions to obtain optimal performance.

### 6.3.2 Brushless in-runner

There is such a massive range of in-runners that it’s difficult to suggest a prop for them, however, starting with a 7cell-2S configuration on a 3000kV 20x40mm in-runner an 6x4 or 7x3 would be a minimum starting point and pushing up to a 7x5 depending on if the motor can cope with the load.

## 6.4 Center of Gravity (CoG, CG)

The CG is located between 65mm (2-1/4”) and 70mm (2-1/2”) from the join between the wing and the nose-spike. Deviations from this can be based on personal flying preferences.

## 6.5 Launching

DO NOT LAUNCH WITH THE MOTOR RUNNING.

IF YOU LAUNCH WITH THE MOTOR RUNNING YOU WILL BE STRUCK BY THE PROPELLER.

DO NOT LAUNCH WITH THE MOTOR RUNNING.

- Launch the Seether from over your shoulder with a firm throw horizontally forward (don’t try to launch upwards aggressively, the plane will only stall and crash)

- Don’t panic about throttling up immediately, the Seether can glide for a reasonable distance.
- Gently throttle up over a period 0.5˜1 second (rapidly opening the throttle will potentially cause a torque roll effect which could cause you to crash if not corrected).
- With a 2205 outrunner motor and 7x6 or 8x4 prop you should be able to climb out at 20 degrees attack.
- Let the Seether gain speed and height until it is about 50m (150’) away from you and then commence your first gentle turn.

## 6.6 Landing

The Seether is a sedate plane when it comes to landing but with a few tips you can make sure things do go well.

- Approach the landing from at least 15m (45’) high as you perform the final turn from about 50˜70m (150’) down wind.
- Reduce the throttle to 50% just as you commence the final turn to line up with the landing strip. As you turn the high attack angle on the turn will cause the Seether to wash off a lot of its speed.
  - WARNING - DO NOT TURN IF YOU ARE ALREADY QUITE SLOW OR LOWER THAN 5M OTHERWISE YOU MIGHT INDUCE A TIP STALL (SUDDEN DROPPING OF ONE WING AND LOSS OF CONTROL).
- The Seether should come into contact, or be very close to contact with the ground as it passes your position, if you’re too high and fast then power up and go around again.
- Do not use excessive aileron movements on landing, remember you do not have a rudder so you cannot correct a misaligned approach too easily - better go around and do it again.
- If you find that the landings are too hot then try dropping the throttle at 10˜15%, this has a very aggressive air-brake type effect, so much so that you may find the Seether will want to land well short of your position.
- Remember to kill the throttle before the plane touches the ground. Failure to stop the motor can result in damaged electrics or model.

# Chapter 7

# Web sites containing further details on various build processes.

- Using laminating film to cover wings.
  - http://www.pldaniels.com/flying/balsa/using-laminating-film-for-models.html
- Using laminating film to cover tails.
  - http://www.pldaniels.com/flying/balsa/laminating-model-aircraft-tails.html
- Video demonstrating covering with laminating film
  - http://www.pldaniels.com/flying/balsa/videos/playflash.html?video=laminating-film-covering&pp=balsa
- Using hotglue and carbon fiber tow for reinforcements
  - http://pldaniels.com/flying/balsa/howtos/carbonfiber-hotglue-composite