

# HAWKER TEMPEST MK. V



The Hawker Tempest was conceived in 1940 as an attempt to improve the performance of the very successful Hawker Typhoon. The improvements were aimed mainly at increasing the high altitude performance and maneuverability. An elliptical wing of thinner overall chord, an updated version of the 24-cylinder Sabre engine, and changes to the vertical stabilizer were among the major changes. The improvements allowed the Tempest to prove itself as a world class ground attack aircraft and a credible air-to-air threat, and the design was so successful that it was used in RAF service from 1944 until 1950, and in the service of foreign air forces until 1958.

The Tempest has a wingspan of 41 feet, a length of 33 feet 8 inches, and a maximum loaded weight of over 13,500 pounds. Its powerplant is a 2,180 hp Rolls-Royce Sabre II, a 24-cylinder, water cooled engine designed in an unusual H-configuration. The massive cooling needs of this engine dictated the forward placement of the large coolant and oil radiators, creating the dis-

tinctive chin inlet which is the primary identifying characteristic of the Typhoon and Tempest lines. The Tempest had a top speed of 435 mph at 17,000 ft. Initial climb rate of 4,700 ft/min. and a max range of 740 miles.

Armament on the Tempest consisted of four 120mm cannons mounted in the wings.



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Thank you for purchasing the Hawker Tempest from Skyshark R/C Corporation. For the first time, R/C enthusiasts have a choice in scale aircraft designs. Our goal, through computer technology and state-of-the-art production techniques, is to offer aircraft which in the past have not been modeled simply because they weren't popular enough to justify mass production. Our production techniques allow us to produce aircraft which, though not as popular and well known as P-51s and P-47s, still offer historical significance (good or bad!), Good looks and flying characteristics, and a uniqueness that is sure to turn heads wherever you take your airplane!

***Your airplane has many unique features in its design:***

### **CAD Design**

CAD design allows strength to be built into the airplane without sacrificing weight. Accurate parts design and placement ensures a perfect fit.

### **CAD Drawn Plans**

The plans in this kit are not copied from a master set! They are originals drawn directly from the CAD program where the airplane was designed. We do this because it allows us to use color, which helps you better visualize the various components of the airplane, and we can use better quality paper, which greatly reduces the possibility of shrinkage. Since you're going to build directly on the plans, they ought to be the proper size! Also, parts placement is guaranteed to be accurate, so you can build a better, straighter model.

### **Laser Cut Parts**

The same program that generates the design and plans also drives the laser, so every part is reproduced exactly as it was designed. Laser cutting also allows us to fit more

parts on each sheet of wood, reducing the waste, and lowering the cost to you. Since laser cutting does not have the same limitations that mechanical cutters do, small and hard-to-produce parts are simply a computer file away, so you get a more accurate airplane.

### **Lightening Holes**

Lightening holes are laser cut into all ribs and formers where possible. This allow us to keep the weight on each plane to a minimum without sacrificing strength.

### **Plastic and Fiberglass**

The cowl is accurately reproduced in high quality fiberglass. The wing fillets, usually hard to reproduce, are preformed; just glue them on and finish with the rest of the airplane. Similarly, the belly pan, normally forgotten, is accurately reproduced; glue it on and finish it for a more accurate airplane.

### ***A Word About the Building Options***

### **Engine Options**

Many parts of the country (and the world) sit at higher elevations. At 7200 feet, a .40 size airplane will barely fly with a .40 engine. The engine size range of .45 to .61 for this kit is designed to compensate for engine performance loss due to elevation. Below 3500 feet in elevation, a good .45 will fly the Tempest with authority. Above 3500 feet, a larger engine will help return the airplane to sea level performance.

### **Retract Options**

Retract installation is shown on the plans and explained in these instructions for typical retract installations. While we don't recommend any retracts specifically, Springairs are shown as a typical installation. Follow the instructions provided with the retracts of your choice for proper installation.

### **Flaps**

Flaps on an airplane this size add complexity and weight that is not offset by better performance. For this reason, flaps are not shown as a building option. If you wish to add flaps, you're on your own!

## **General Building Information**

The Tempest can be built by a person with average building skills. It is designed for someone who has built a trainer or low wing sport plane. No unusual building techniques are required, although more difficult areas are explained in detail where necessary. Certain steps in the building process must be followed as depicted, or you might find yourself digging back into the structure to redo something! These areas are outlined when necessary.

Occasionally hints will be included at certain building steps. These are not required for completion, rather they are tips intended to ease a particular process.

The laser does not cut through the wood, it burns its way through. As a result of this, occasionally there will be scorching on the surface of the wood. This is normal, and is only a surface discoloration, and does not affect the wood in any other way. Similarly, the laser settings are optimized for wood density averages, so occasionally, due to variations even in individual sheets, some areas might not cut through completely. This is apparent mainly with the plywood. Simply use care in removing the parts from the sheets; most of the time, the parts will literally fall out of the sheets!

The Center Wing Section building steps are shown for both Fixed Gear and Retract installation. Decide which gear installation you want to go with, and use the appropriate building section.

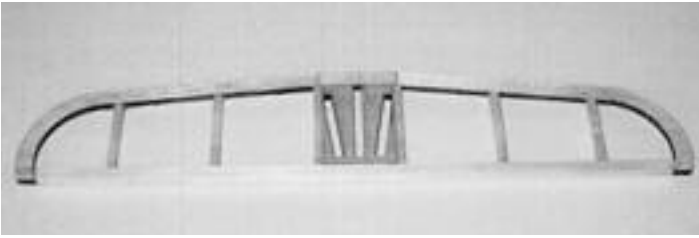
Hardware and a motor mount are not included in the kit. There are so many choices for quality hardware that these choices are left to the individual preferences of the builder, rather than include something in the kit that you'll probably throw away anyway. A vibration-dampening motor mount is recommended for use regardless of engine choice, so select a mount suited to your particular engine. The decals provided are fuel-proof but still should be clear-coated to insure that fuel doesn't soak underneath them.

This aircraft is not a toy. It must be flown in a responsible manner according to the rules set forth by the Academy of Model Aeronautics. The builder assumes the responsibility for the proper assembly and operation of this product. Skyshark R/C Corporation shall have no liability whatsoever, implied or expressed, arising out of the intentional or unintentional neglect, misuse, abuse, or abnormal usage of this product. Skyshark R/C Corporation shall have no liability whatsoever arising from the improper or wrongful assembly of the product nor shall it have any liability due to the improper or wrongful use of the assembled product. Skyshark R/C Corporation shall have no liability for any and all additions, alterations, and modifications of this product.

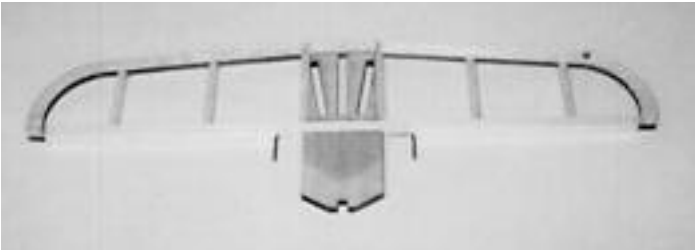
Having said that mouthful, turn the page and start building the best airplane on the market!

## **Notes:**

## Horizontal Stabilizer Assembly



1. Pin S1, and both S2s to the board. Cut S3 from  $\frac{1}{4} \times \frac{3}{8}$  balsa stock, sand to fit, and pin to the board. Pin S4 to the board and glue all the pieces. Cut stab reinforcements from  $\frac{1}{4} \times \frac{1}{4}$  balsa stock and glue in place.



2. Cut a groove in S5 for the pre-formed elevator wire. Lightly coat the wire with oil or petroleum jelly and pin S5 with the elevator wire in place. Glue edges of S5 to the stab assembly. The coating of oil will prevent the wire from being glued and will allow it to move freely.

### Hint:

Hinges are not provided in the kit because everyone has their own idea of the best hinge. Although not shown, it is a good idea to select hinge points now, before sheeting, and add reinforcements to the hinge attach areas. Cut small pieces of  $\frac{1}{4} \times \frac{1}{4}$  scrap balsa and glue behind the trailing edge to add to the amount of wood the hinges will have to hold on to. Use three evenly spaced hinge points per control surface for best results.



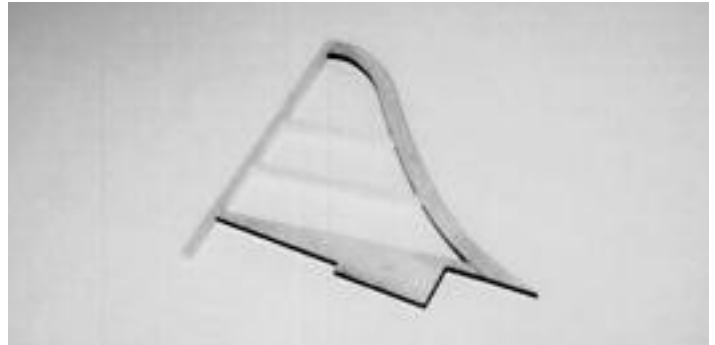
3. Sand the stab assembly and sheet the bottom with balsa sheeting. Cut slots in the sheeting to match the angled slots in S4. Sheet the top of the stab similarly. For the top, cut a slot in the sheeting to match the center slot in S4. These slots will help align the stabilizers with the fuselage. Do not cut the slots all the way through both top and bottom sheets.

4. Sand the leading edges to shape.

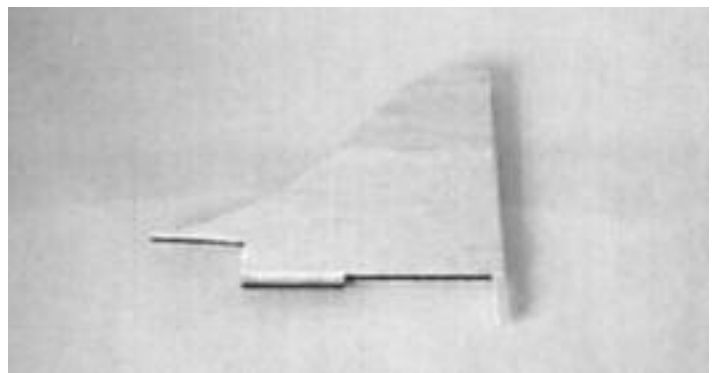
### Hint:

Most of the sheeting on the model will require edge gluing several pieces together. A smoother finish will result from gluing the sheets together and sanding smooth prior to placing the sheets on the assemblies. Use wax paper under the sheets while gluing, or you may inadvertently glue the sheets to your work table!

## Vertical Stabilizer Assembly

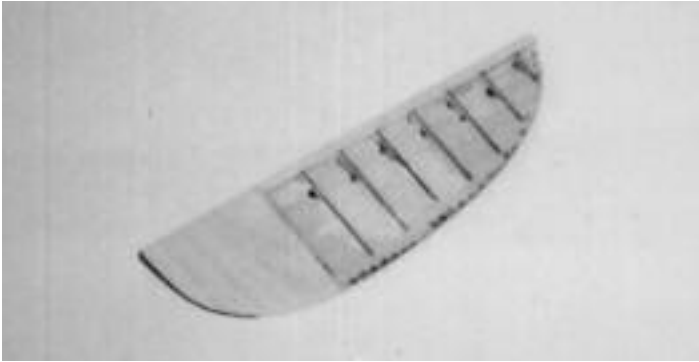


1. Pin S6 and S7 to the board. Cut the fin post from  $\frac{1}{4} \times \frac{1}{4}$  balsa stock, making sure the post extends to the point shown on the plans. Pin in place.
2. Cut the stab stringers from  $\frac{1}{4} \times \frac{1}{4}$  balsa stock and pin in place. Glue all the parts.



3. Sheet both sides of the vertical stabilizer except for the tab on S6 and the fin post. Sand the leading edge to shape.

## Rudder Assembly

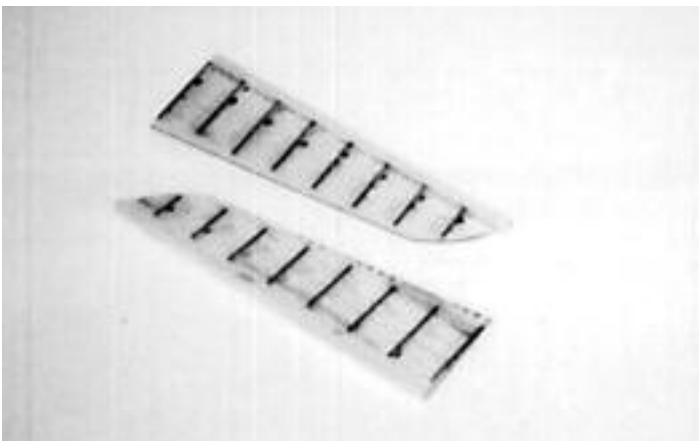


1. Slide R3 through R10 into the slots in R1. Cut a piece of  $\frac{1}{4} \times \frac{3}{8}$  balsa stock to size and center R1 on this piece, aligning all ribs. Glue all pieces at this time.
2. Glue R2 to the bottom of the rudder assembly. Sand the trailing edge of R2 to match the taper of the ribs. Set this assembly aside for now.

### Hint:

The control surfaces strength and rigidity comes from the glue joint between the ribs and center piece. The best way to assure a good glue joint is after gluing to the  $\frac{1}{4} \times \frac{3}{8}$  balsa stick, run thin CA along the edges of the ribs, making sure the ends receive glue. The thin CA will wick along the seams. After this is complete, if you still aren't satisfied with the strength (along the outside edge), thinly coat the centerpiece with CA. When dry, this will harden the outer edges.

## Elevator Assembly



1. Slide E2 through E11 into the slots in E1. Cut a piece from  $\frac{1}{4} \times \frac{3}{8}$  balsa stock, align E1 and all the ribs to this piece and glue. Sand the edges smooth.
2. Repeat Step 1 for the remaining elevator. Set these assemblies aside for now.

## Aileron Assembly

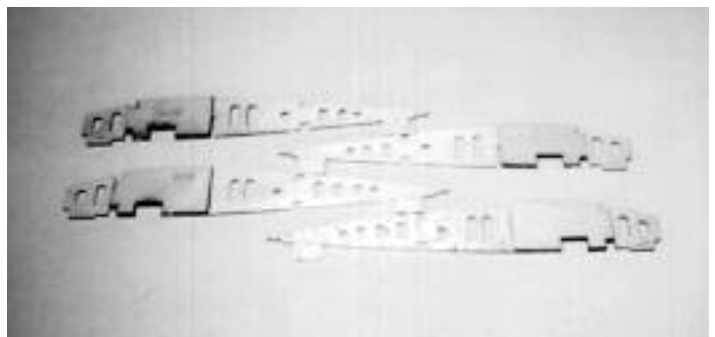


1. Cut an  $10 \frac{1}{2}$ " piece of  $\frac{1}{4} \times \frac{3}{4}$  balsa stock. Slide A2 thru A12 into the slots in A1. Align A1 and the ribs on the  $\frac{1}{4} \times \frac{3}{4}$  balsa piece and glue. Sand the ends smooth.
2. Repeat Step 1 for the other aileron. Set these assemblies aside for now. All control surfaces will be finished later.

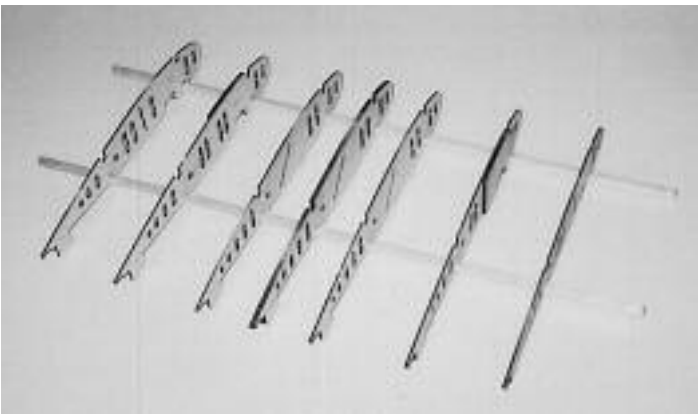
## Center Wing Section

You must decide on fixed gear or retract installation before building the wing. Both installation procedures are detailed. If you install retracts, it is recommended that you read the instructions provided with the retracts at this time to familiarize yourself with the process, and to aid in adapting your retracts into this wing. Fixed gear installation is shown first, followed by Retract installation. Either procedure will build the center wing panel, so you don't have to jump back and forth.

## Fixed Gear Installation

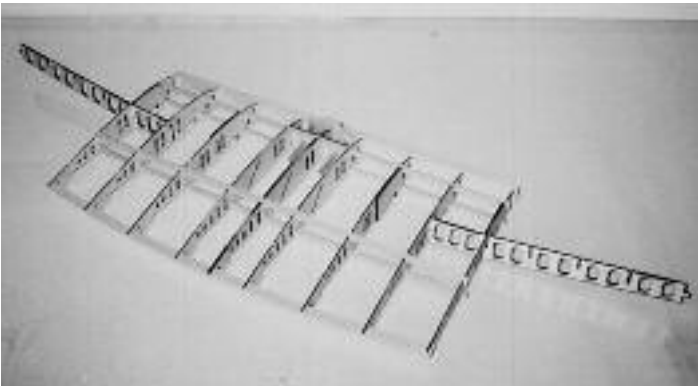


1. Epoxy W3B Ply Gear Support to W3. Make a left and a right side (double-check yourself here - it's easy to make two left sides!).
2. Epoxy W5B Ply Gear Support to W5. Make a left and right side (repeat the double-check procedure!).



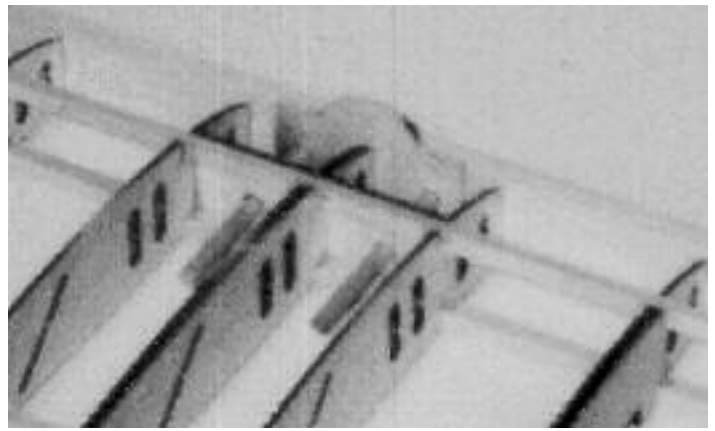
3. Glue two W1s together.

4. Cut four spars from  $\frac{1}{4} \times \frac{1}{4} \times 36$  balsa stock. Lay the bottom spars in place on the plans. Align W1 on the plans and pin in place. Glue bottom spars to W1. Slide W16 Ply Servo Tray into the slot in W1, but do not glue it yet.
5. Place W2, W3 and W4 on the plans and pin in place. The Ply Gear Support on W3 will face outboard. Glue bottom spars to the ribs. Slight upward pressure will be needed on the spars as you move outboard to fully seat the spars in the ribs. Do not glue W5 in place yet.



6. Slide the end of W15 Ply Spar in the slot in W4. Slide W5 over W15 and glue in place. Note that W15 does not line up parallel to the balsa spars. Repeat for the other side.

7. Glue the top spars in place.
8. Cut the  $\frac{3}{8} \times 1 \times 36$  balsa leading edge to length and glue in place, leaving at least  $\frac{1}{16}$ " overlapping the ribs.
9. Glue W13 Trailing Edges in place.



10. Glue the W17 Ply Dowel Supports in place between W1 and W2, with the arrows pointing up and inboard. Using F19 as a guide as shown in Figure 12, mark and drill  $\frac{1}{4}$ " holes in the leading edge for the dowels. Remove F19.

11. Cut the  $\frac{1}{4} \times 6$  birch dowel into two 3" pieces. Slide the dowels into the holes leaving at least  $\frac{1}{2}$ " protruding from the front. Slide F19 onto the dowels to align them, and glue the dowels in place. Do not glue F19 in place as well!. Remove F19 and set it aside.

12. Cut shear webs from  $\frac{1}{16}$ " balsa sheet and glue to front and rear spar as shown on the plans.

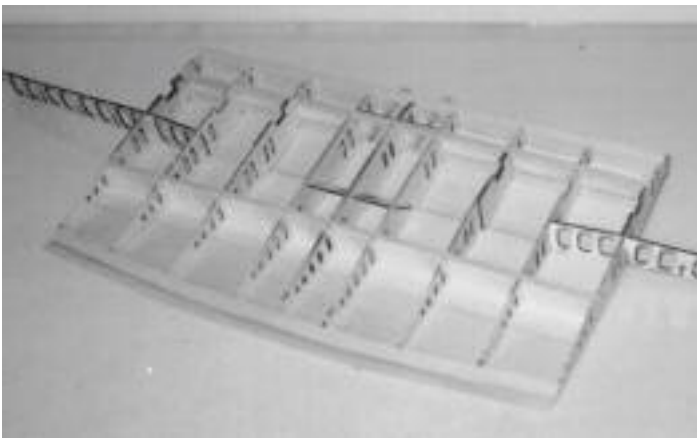
13. Glue W16 Servo Tray in place in the slots in W1 and W2.

14. Cut three  $\frac{1}{16} \times 4 \times 48$  balsa sheets to make six 22" sheets. Edge glue three sheets together to make the center wing section top sheeting. Edge glue the remaining sheets together for the bottom sheeting.



15. Lightly sand the top of the wing panel, smoothing out any rough glue joints.

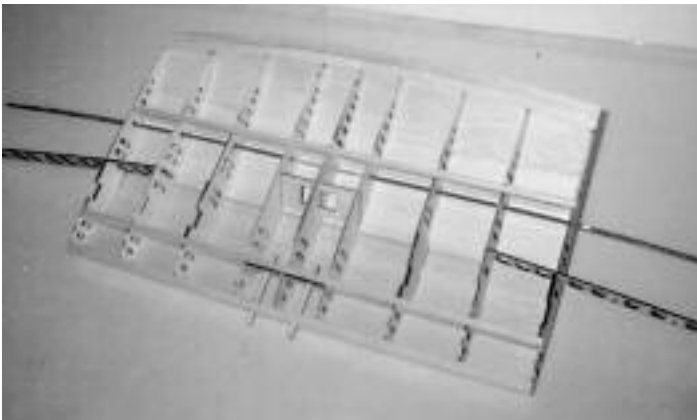
16. Sheet the top of the center wing panel. The sheeting does not overlap the leading edge, it butt up against it, so a light amount of sanding will be needed at the leading edge for a good fit.



17. Sand the sheeting, leading edges, and balsa spars flush with W5.

18. Trim the trailing edge sheeting to 1/2" from the W13 trailing edge piece. Remove the rib tabs and lightly sand the bottom of the ribs smooth.

**Note:** You may use any type of aileron linkage setup you desire. Pushrod installation as explained next uses Sullivan Gold-N-Rods and a Dubro Aileron Ball-Link Connector.



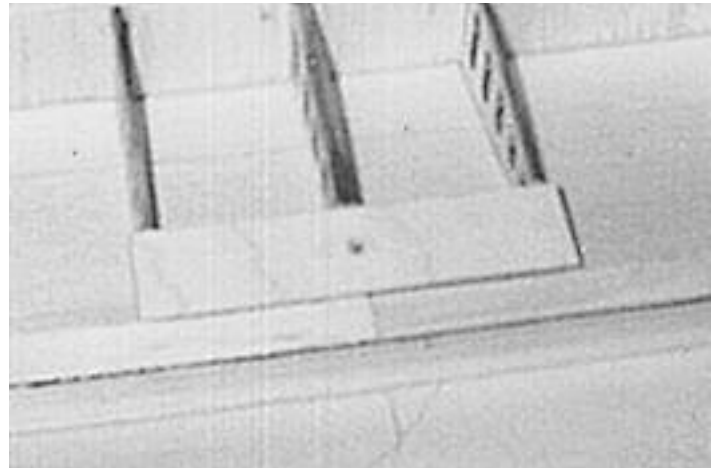
23. Cut one 48" red pushrod housing into two 20" lengths. Cut one 48" yellow pushrod into two 22" lengths. Assemble the pushrods, aileron ball-link connector, and two 2-56 studs into one continuous pushrod. Slide this assembly through the pushrod holes just ahead of the rear spar, centering the aileron connector at W1. Slide the pushrod housings over the pushrods so the ends extend just past W2. Glue the pushrod housings at all the holes except at W2. Leave these free-floating.



24. Epoxy the W19 Gear Blocks in place as depicted in the plans. Epoxy the W20 Gear Block Anchor in place as depicted, with the slot facing W3.

25. Using a 5/32 drill bit, drill through the gear block to open up the slot in W20. Use caution: don't drill through the top wing sheeting!

26. Brace W20 with tri-stock for support. Brace W15 Ply Spar with tri-stock.



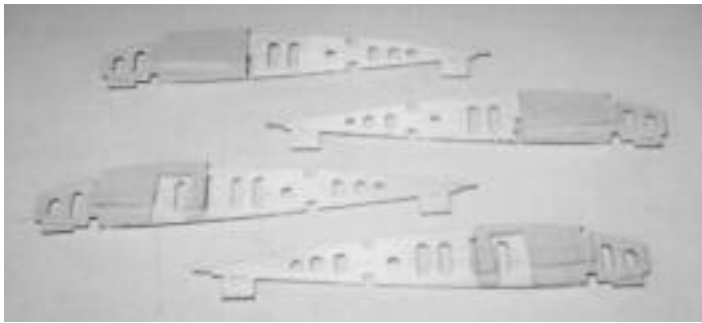
26. Open up the recess at the rear of W1 and W2, and install W18 Ply Holddown Plate. Drill a small pilot hole through W18, W1, and the top sheeting. This will locate the hole for the 1/4" wing holddown bolt.

27. Glue the bottom sheeting to the center wing panel. Trim the trailing edge to match the top sheeting. Sand the sheeting flush with W5. Sand the leading edge to shape.

28. Open up the slots along the gear blocks for the wire gear legs.

## Retract Installation

*This section is for retract installation. If you installed fixed gear, skip this entire section and continue with building the Right Wing Panel. The following steps show typical pneumatic retract installation procedures.*



1R. Cut 2 each of W4R, W4R1, W5R, and W5R1 from 1/8" ply. Cut 2 W20s from 1/4" ply.

2R. Epoxy W4R to W4. Make a right and left side (not two left sides!). Epoxy W5R to W5. Make a right and left side.

3R. Epoxy W4R1 to W4R, lining up the upper edges. This creates a solid brace for W20 to set on. Repeat for the other side. Duplicate this procedure with W5R1 to W5R.



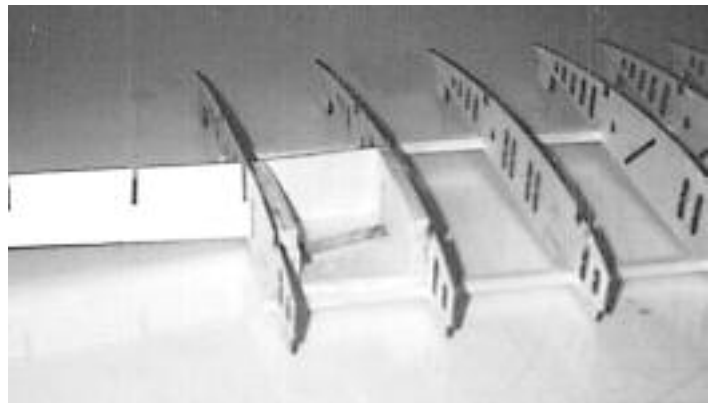
4R. Glue two W1s together.

5R. Cut four spars from 1/4 x 1/4 x 36 balsa stock. Lay the bottom spars in place on the plans. Align W1 on the plans and pin in place. Glue bottom spars to W1. Slide W16 Ply Servo Tray into the slot in W1, but do not glue it yet.

6R. Place W2, W3 and W4 on the plans and pin in place. The Ply Gear Support on W3 will face outboard. Glue bottom spars to the ribs. Slight upward pressure will be needed on the spars as you move outboard to fully seat the spars in the ribs. Do not glue W5 in place yet.

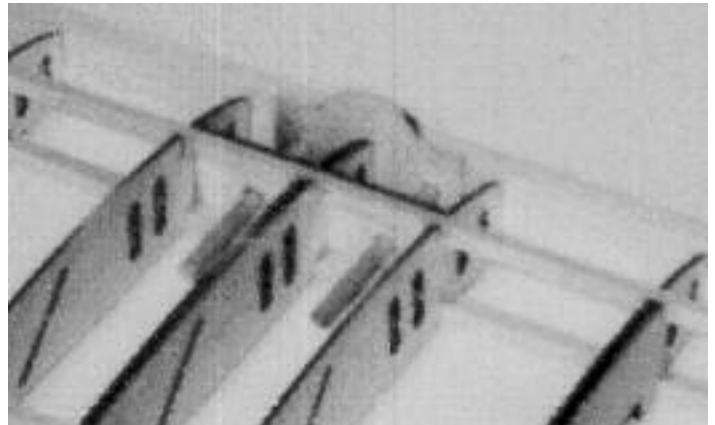
7R. Slide the end of W15 Ply Spar in the slot in W4. Slide W5 over W15 and glue in place. Note that W15 does not line up parallel to the balsa spars. Repeat for the other side.

8R. Glue the top spars in place.



9R. Slide the W20 Retract Plate through the slot between the bottom spar and W4 and W5. Some trimming of the bottom spar may be required - try for a snug fit. Epoxy W20 to W4, W5, W15, and the bottom spar.

10R. Brace W20 to W15 with tri-stock, and brace W15 to the ribs with tri-stock.



11R. Cut the 3/8 x 1 x 36 balsa leading edge to length and glue in place, leaving at least 1/16" overlapping the ribs.

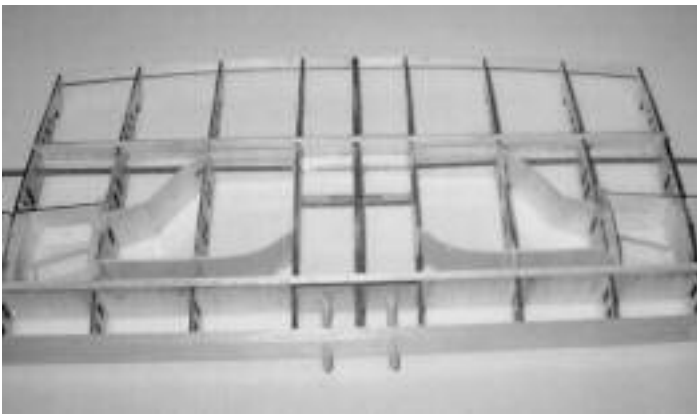
12R. Glue W13 Trailing Edges in place.

13R. Glue the W17 Ply Dowel Supports in place between W1 and W2, with the arrows pointing up and inboard. Using F19 as a guide, mark and drill 1/4" holes in the leading edge for the dowels. Remove F19.

14R. Cut the 1/4 x 6 birch dowel into two 3" pieces. Slide the dowels into the holes leaving at least 1/2" protruding from the front. Slide F19 onto the dowels to align them, and glue the dowels in place. Do not glue F19 in place as well!. Remove F19 and set it aside.

15R. Cut shear webs from 1/16" balsa sheet and glue to front and rear spar as shown on the plans.

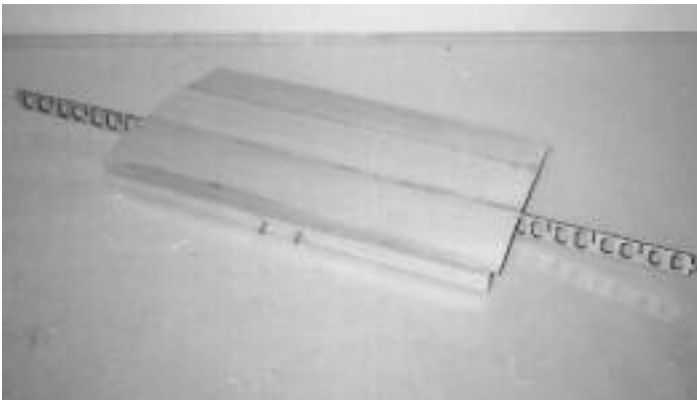
16R. Glue W16 Servo Tray in place in the slots in W1 and W2.



**This step will explain how to install scale-like wheel wells. If you so not wish to do this, install the wheel wells of your choice.**

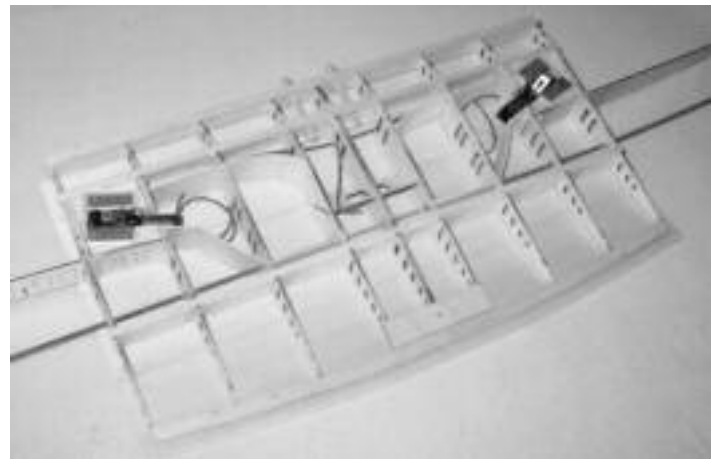
17R. Using spare 1/16" balsa sheet, insert panels vertically about 3/16" inside the blue gear door outline shown on the plans. The panels should rest on the plans and extend slightly above the height of the ribs. Work carefully, try for a snug fit - care here will result in a good looking wheel well when you're finished. Leave the ribs intact - work around them. When complete, carefully sand the tops of the wheel wells flush with the ribs.

18R. Cut three 1/16 x 4 x 48 balsa sheets to make six 22" sheets. Edge glue three sheets together to make the center wing section top sheeting. Edge glue the remaining sheets together for the bottom sheeting.



19R. Lightly sand the top of the wing panel, smoothing out any rough glue joints.

20R. Sheet the top of the center wing panel. The sheeting does not overlap the leading edge, it butt up against it, so a light amount of sanding will be needed at the leading edge for a good fit.



21R. Sand the sheeting, leading edges, and balsa spars flush with W5. Carefully sand the wheel wells flush with the bottom of the ribs.

22R. Trim the trailing edge sheeting to 1/2" from the W13 trailing edge piece. Remove the rib tabs and lightly sand the bottom of the ribs smooth.

**Note:** You may use any type of aileron linkage setup you desire. Pushrod installation as explained next uses Sullivan Gold-N-Rods and a Dubro aileron Ball-Link Connector.

23R. Cut one 48" red pushrod housing into two 20" lengths. Cut one 48" yellow pushrod into two 22" lengths. Assemble the pushrods, aileron ball-link connector, and two 2-56 studs into one continuous pushrod. Slide this assembly through the pushrod holes just ahead of the rear spar, centering the aileron connector at W1. Slide the pushrod housings over the pushrods so the ends extend just past W2. Glue the pushrod housings at all the holes except at W2. Leave these free-floating.

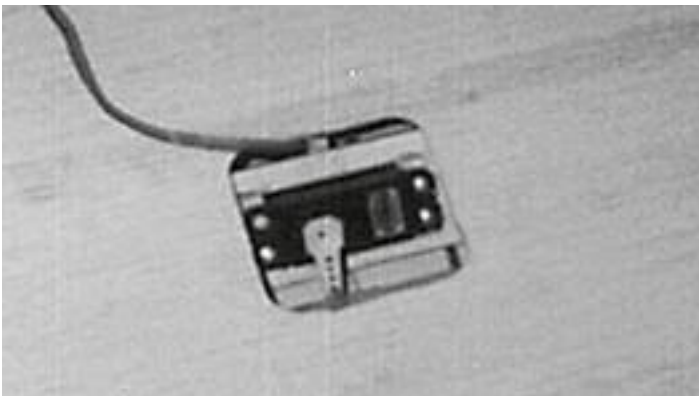


- 24R. Run the air lines (for pneumatic retracts) or install the servo and linkage for mechanical retracts.

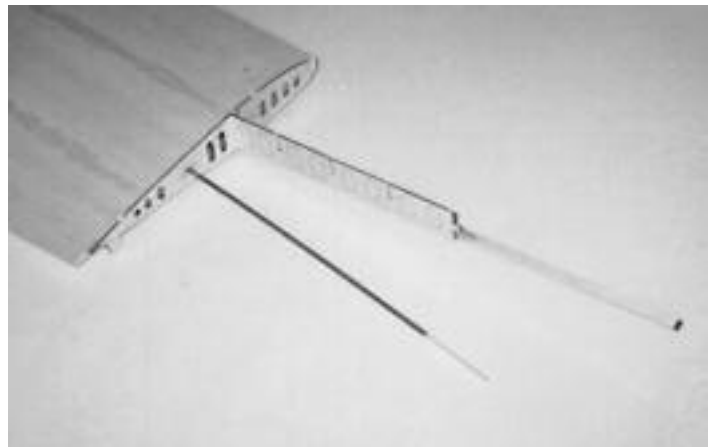
25R. Open up the recess at the rear of W1 and W2, and install W18 Ply Holddown Plate. Drill a small pilot hole through W18, W1, and the top sheeting. This will locate the hole for the 1/4" wing hold-down bolt.

26R. Glue the bottom sheeting to the center wing panel. Trim the trailing edge to match the top wing sheeting. Sand the sheeting flush with W5, and sand the leading edge to shape. Open up the wheel wells and retract wells.

## Right Wing Panel Assembly

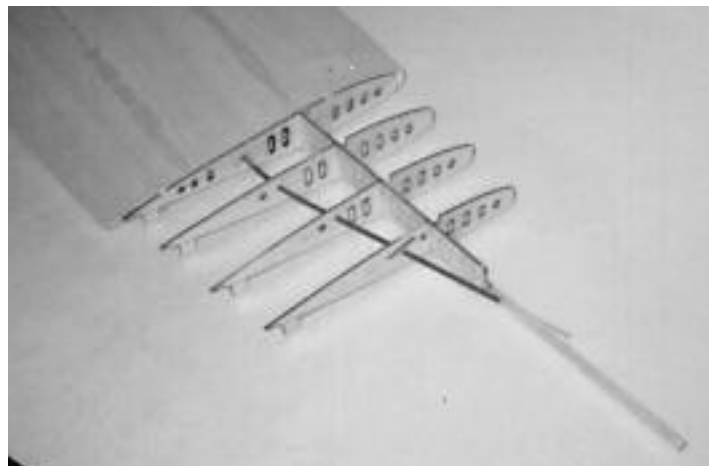


- 1. Cut out the opening in the center wing panel for the aileron servo, and remove the material surrounding the servo location as shown on the plans. Install the servo (the servo tray is designed to accommodate a standard size servo mounted on 1/4" blocks as shown on the plans), install the ball-link onto a (long) servo arm, and install the arm. Check for clearance and fit, and secure.



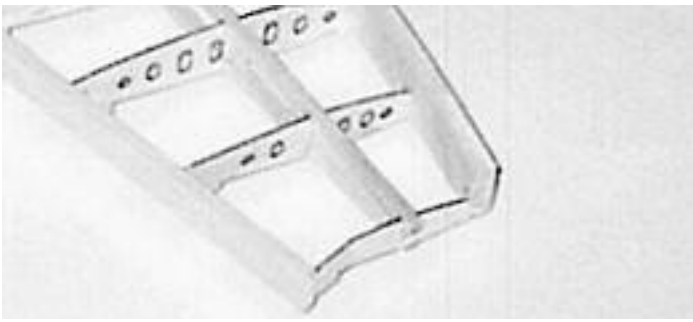
- 2. Cut away the balsa surrounding the pushrod hole in W5A, enough to slide W5A next to W5. Align W5A with W5 (they're the same size) and glue in place.

3. Using the 1/4 x 1/4 balsa left over from the center wing section spars, glue the spar into the slot in W5A. Glue the spar to W15, making sure it's flush with the bottom edge.

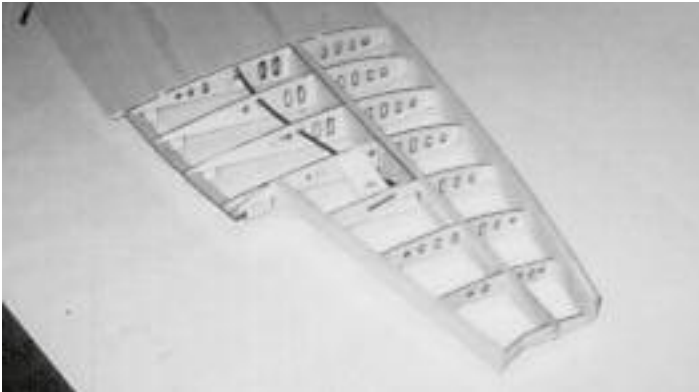


- 4. Glue W6, W7, and W8 in place. Use caution while sliding the ribs in place, due to the tight fit of the slots in the ribs and spar. Be sure to feed the pushrod through the hole in the ribs as you slide it in. Do not glue the pushrod housing to W8 - leave it free-floating.

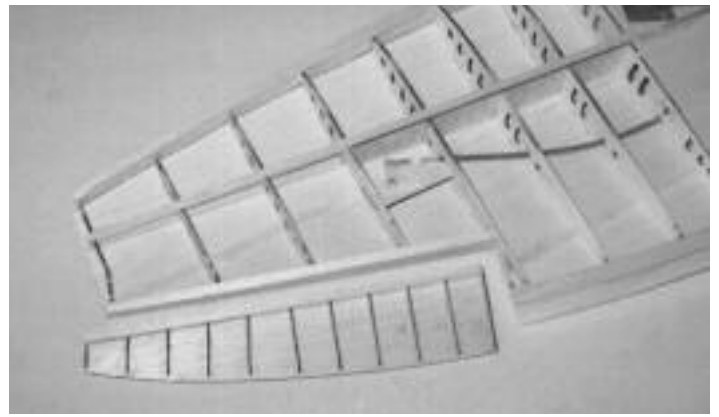
4. Drill a hole in W21 in the location shown on the plans to locate the bellcrank. Assemble the bellcrank on W21.



- 5. Test fit the bellcrank assembly to W8. Cut the pushrod and pushrod housing to fit. Install a 2-56 stud and clevis on the pushrod, secure this to the bellcrank, and slide W21 into the slot in W8. Note that the bellcrank as installed is on the bottom of W21.
- 6. Glue W9 to W15, W21, and the bottom spar. Glue W10 and W11 in place.
- 7. Score W12 along the line. Gently bend W12 to the angle shown on the plans and glue in place.



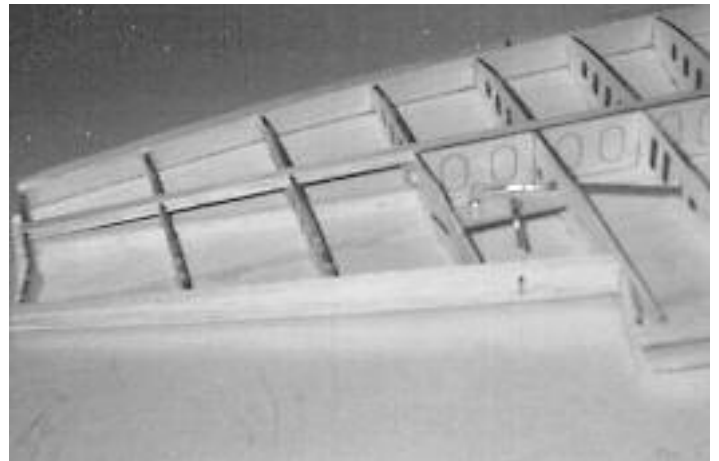
- 8. Glue W8A in place.
- 9. Glue W14 Trailing Edge in place.
- 10. Glue the  $\frac{1}{4} \times \frac{1}{4}$  balsa spar in place.
- 11. Cut two 24" pieces from the  $\frac{3}{8} \times 1 \times 48$  Leading Edge. Soak the leading edge in water or a water/ammonia mix (really soak it - it will take a while for the wood to become pliable). Using moderate pressure, bend the leading edge to the radius shown on the plans. Glue the leading edge in place.
- 12. Glue  $\frac{1}{4} \times \frac{3}{4}$  balsa stock to the trailing edges of W8 through W12 as shown in Figure 29. Sand the top to match the rib camber.
- 13. Cut a  $\frac{1}{16} \times 4 \times 36$  balsa sheet into two 17" pieces. Edge glue these pieces. Cut an additional sheet to 9" and edge glue this sheet to form the top wing panel sheeting.
- 14. Shape the sheeting to conform to the leading edge curve and center wing section sheeting, and sheet the top of the right wing panel.



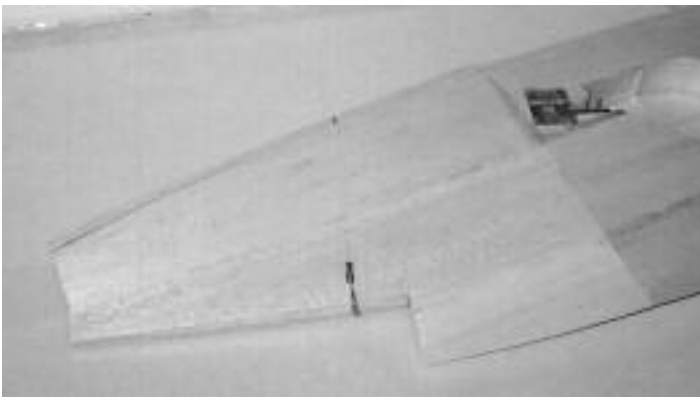
- 15. Trim the trailing edge sheeting to  $\frac{1}{2}$ " of W14, and sand the sheeting flush with all other surfaces.
- 16. Remove the rib tabs and lightly sand the ribs smooth. Sand the trailing edge sheeting to a beveled edge.

Hint:

Fit the aileron to the wing to verify the trim length for the trailing edge sheeting. This will ensure a good aileron to wing fit during final assembly.

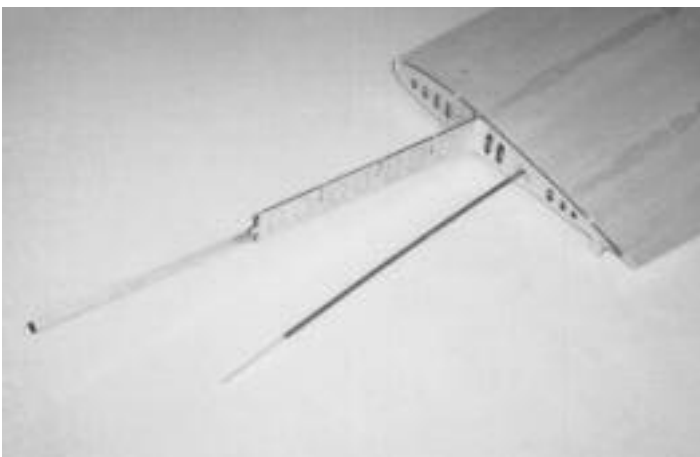


- 17. Cut the pushrod link to length, make a Z-bend in it, and install on the bellcrank. Align it, and draw marks on the leading edge and trailing edge to locate the hole in the bottom sheeting for the pushrod.

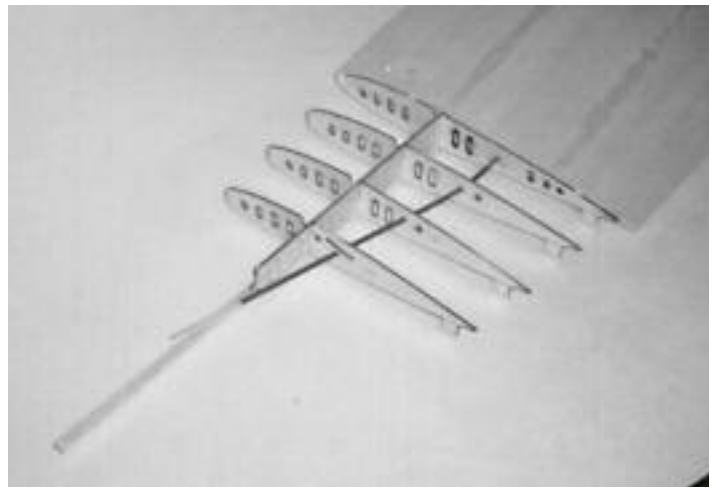


- 18. Sand the  $\frac{1}{4} \times \frac{3}{4}$  balsa trailing edge to match the bottoms of the ribs, and lightly sand the bottom of the right wing panel smooth.
- 19. Create a sheet as explained in Step 13, and sheet the bottom of the right wing panel.
- 20. Using the marks you made previously, locate and cut out the slot for the pushrod.
- 21. Trim the bottom sheeting trailing edge even with the top sheeting, and sand all edges flush. See Figure 33.
- 22. Sand the leading edge to shape.
- 23. Glue the wingtip on and sand to shape. Use the aileron as a guide for shaping the wingtip trailing edge.

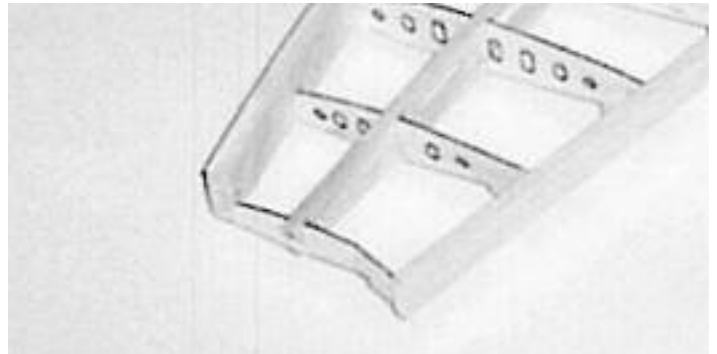
### Left Wing Panel Assembly



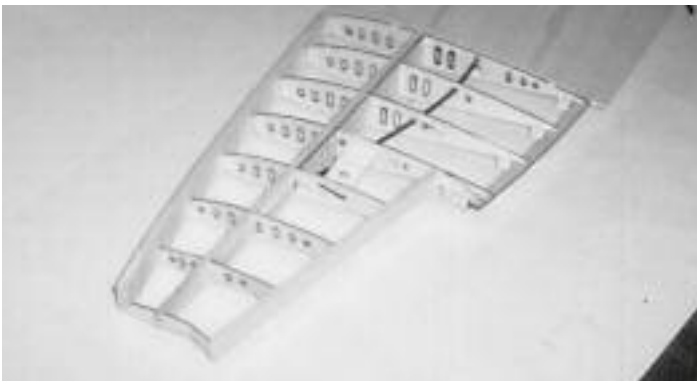
- 1. Cut away the balsa surrounding the pushrod hole in W5A, enough to slide W5A next to W5. Align W5A with W5 (they're the same size) and glue in place.
- 2. Using the  $\frac{1}{4} \times \frac{1}{4}$  balsa left over from the center wing section spars, glue the spar into the slot in W5A. Glue the spar to W15, making sure it's flush with the bottom edge.



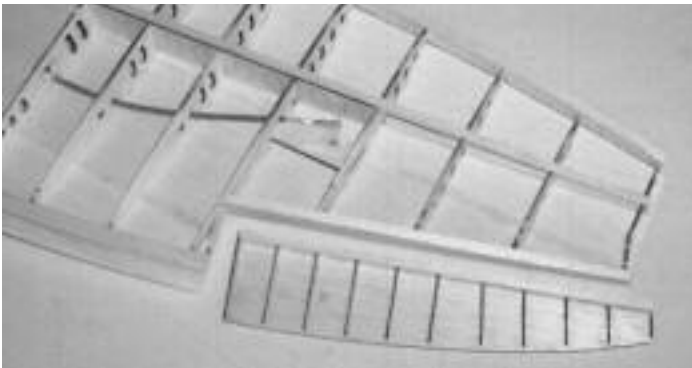
- 3. Glue W6, W7, and W8 in place. Use caution while sliding the ribs in place, due to the tight fit of the slots in the ribs and spar. Be sure to feed the pushrod through the hole in the ribs as you slide it in. Do not glue the pushrod housing to W8 - leave it free-floating.
- 4. Drill a hole in W21 in the location shown on the plans to locate the bellcrank. Assemble the bellcrank on W21.



- 5. Test fit the bellcrank assembly to W8. Cut the pushrod and pushrod housing to fit. Install a 2-56 stud and clevis on the pushrod, secure this to the bellcrank, and slide W21 into the slot in W8. Note that the bellcrank as installed is on the bottom of W21.
- 6. Glue W9 to W15, W21, and the bottom spar. Glue W10 and W11 in place.
- 7. Score W12 along the line. Gently bend W12 to the angle shown on the plans and glue in place.



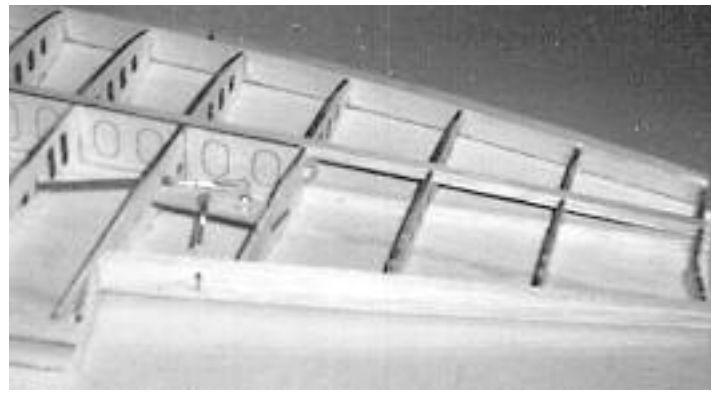
- 8. Glue W8A in place.
- 9. Glue W14 Trailing Edge in place.
- 10. Glue the  $\frac{1}{4} \times \frac{1}{4}$  balsa spar in place.
- 11. Cut two 24" pieces from the  $\frac{3}{8} \times 1 \times 48$  Leading Edge. Soak the leading edge in water or a water/ammonia mix (really soak it - it will take a while for the wood to become pliable). Using moderate pressure, bend the leading edge to the radius shown on the plans. Glue the leading edge in place.
- 12. Glue  $\frac{1}{4} \times \frac{3}{4}$  balsa stock to the trailing edges of W8 through W12. Sand the top to match the rib camber.
- 13. Cut a  $\frac{1}{16} \times 4 \times 36$  balsa sheet into two 17" pieces. Edge glue these pieces. Cut an additional sheet to 9" and edge glue this sheet to form the top wing panel sheeting.



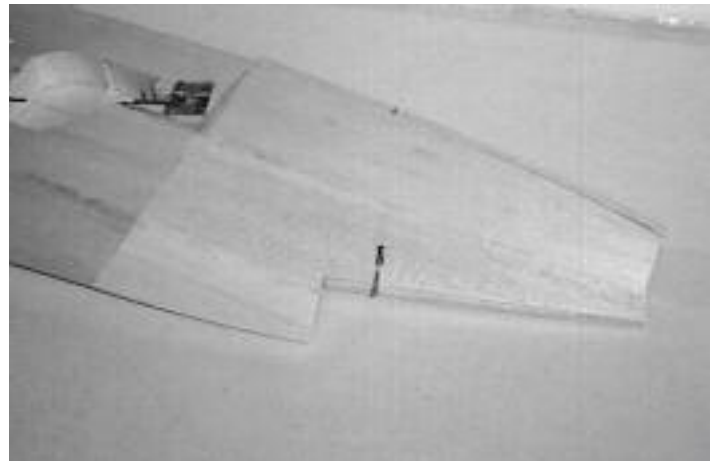
- 14. Shape the sheeting to conform to the leading edge curve and center wing section sheeting, and sheet the top of the right wing panel.
- 15. Trim the trailing edge sheeting to  $\frac{1}{2}$ " of W14, and sand the sheeting flush with all other surfaces.

**Hint:**  
**Fit the aileron to the wing to verify the trim length for the trailing edge sheeting. This will ensure a good aileron to wing fit during final assembly.**

- 16. Remove the rib tabs and lightly sand the ribs smooth. Sand the trailing edge sheeting to a beveled edge.



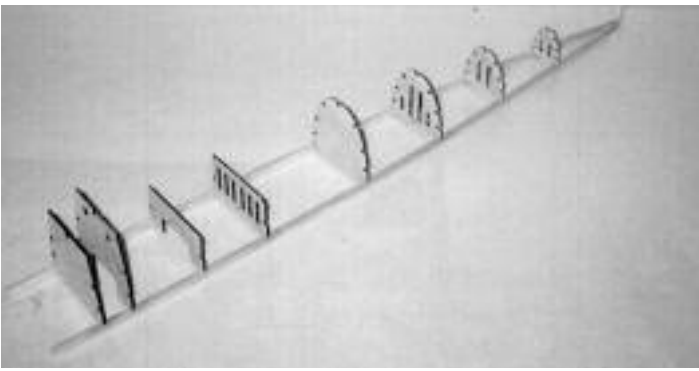
- 17. Cut the pushrod link to length, make a Z-bend in it, and install on the bellcrank. Align it, and draw marks on the leading edge and trailing edge to locate the hole in the bottom sheeting for the pushrod.



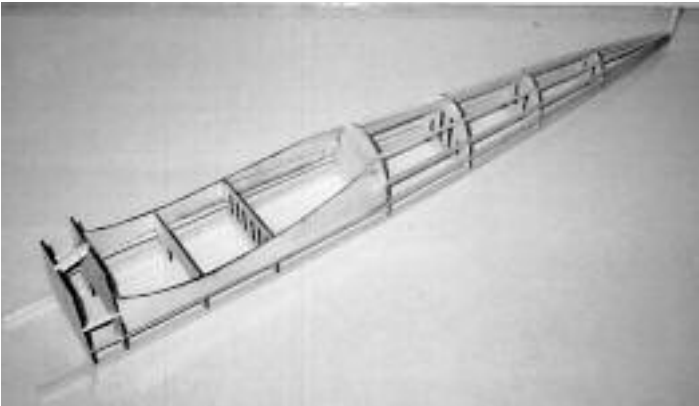
- 18. Sand the  $\frac{1}{4} \times \frac{3}{4}$  balsa trailing edge to match the bottoms of the ribs, and lightly sand the bottom of the right wing panel smooth.
- 19. Create a sheet as explained in Step 13, and sheet the bottom of the right wing panel.
- 20. Using the marks you made previously, locate and cut out the slot for the pushrod.
- 21. Trim the bottom sheeting trailing edge even with the top sheeting, and sand all edges flush.
- 22. Sand the leading edge to shape.
- 23. Glue the wingtip on and sand to shape. Use the aileron as a guide for shaping the wingtip trailing edge.

## Fuselage Assembly

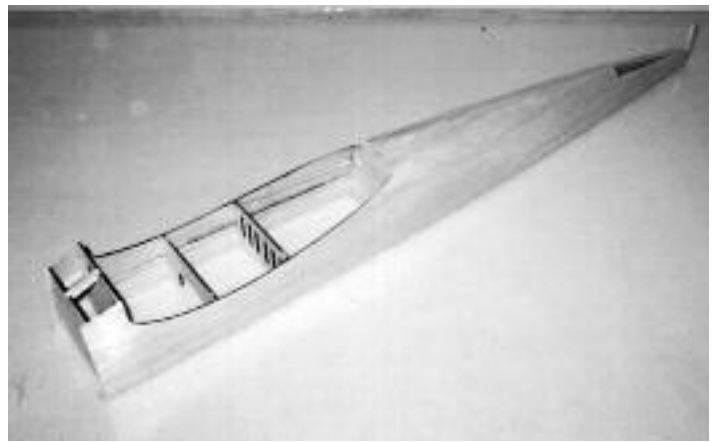
**Note:** The bottom half of the fuselage is built first, using the plans as a guide. The top half is built over the bottom.



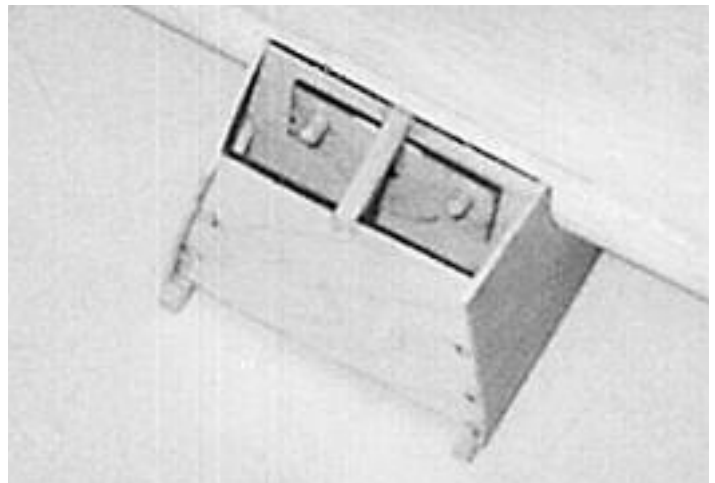
1. Pin  $\frac{1}{4} \times \frac{1}{4} \times 36$  balsa stock in place on the fuselage top view.
2. Glue a 2" piece of  $\frac{1}{4} \times \frac{1}{4}$  balsa stock in place as a fin post.
3. Glue F1A and F2A ply formers in place.
4. Glue F3A through F8A balsa formers in place.



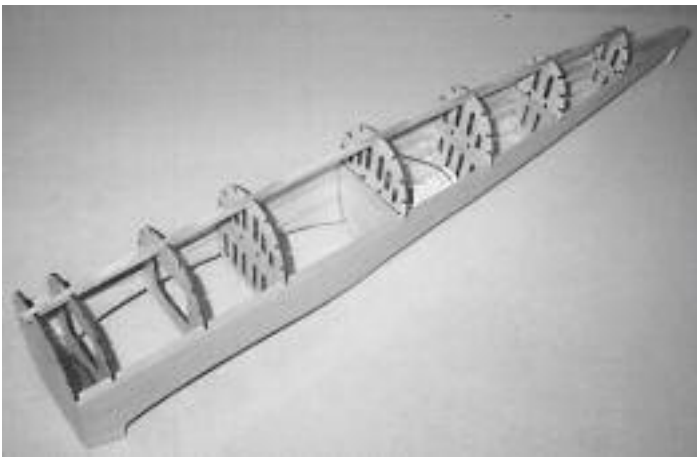
5. Glue  $\frac{1}{4} \times \frac{1}{4}$  balsa stock to F5A through F8A as a keel support. The keel support does not extend aft of F8A.
6. Glue a short piece of  $\frac{1}{4} \times \frac{1}{4}$  balsa stock in the notches in F1A and F2A. Leave at least  $\frac{1}{8}$ " in front of F1A.
7. Working alternately side to side (this will help keep the fuselage straight), glue  $\frac{1}{8} \times \frac{1}{4}$  balsa stringers in the notches along the formers. Note that the stringer in the middle notch on either side is absent between F2A and F4A. Also, this stringer should be thinned the  $\frac{1}{8}$ " thickness between F4A and F5A. Trim all stringers to taper at the fin post. Refer to the side view on the plans.
8. Soak F10 Ply Wing Saddle in water or a water/ammonia mix. Bend the ends of F10 to match the contours of F2A at the front and F5A at the rear. Resting F10 on the first stringer, securely glue both F10s in place. See Figure 40.
9. Sand down any high spots or glue joints on the assembly.



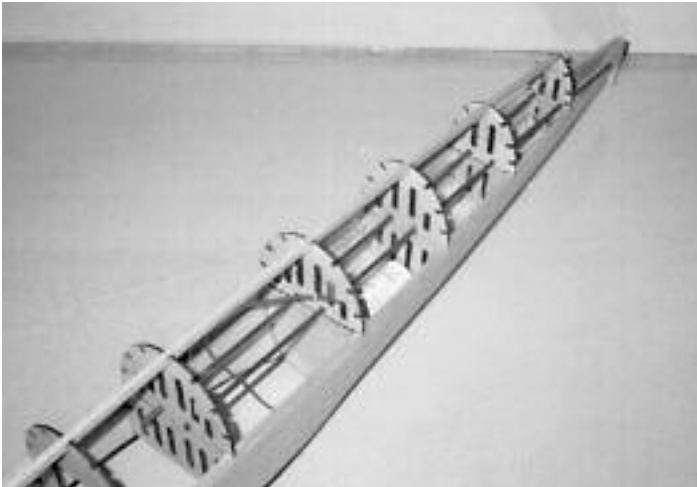
10. Cut several short pieces of  $\frac{1}{8} \times \frac{1}{4}$  balsa scrap and pin to the board against the sides of the assembly. This will leave  $\frac{1}{8}$ " spacing for the bottom and top sheeting.
11. Using two  $\frac{1}{16} \times 4 \times 36$  balsa sheets, sheet the fuselage bottom half. To ensure a straight fuselage, glue both sheets to their respective sides simultaneously, and work both sides up the framework at the same time. For best results, work slowly, wet the sheets to keep them workable, and glue small sections. Don't try to glue the entire side at once. Do not sheet the opening at the bottom between F1A and F2A yet.



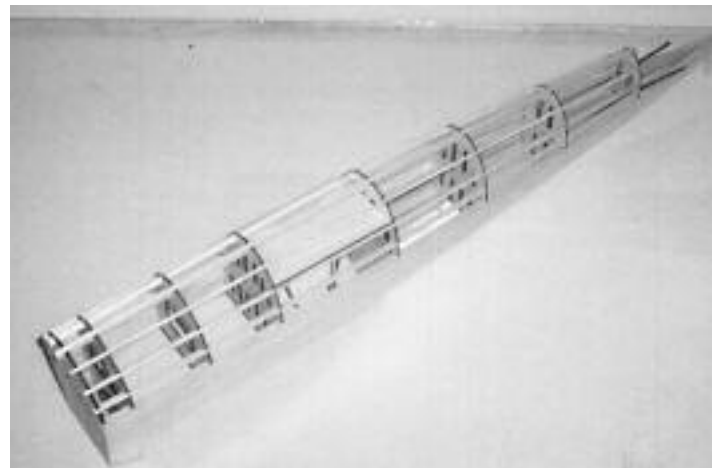
12. Trim and sand the sheeting along the wing saddle, and set the wing in place. Slide F19 through the opening between F1A and F2A and slide onto the wing dowels. Center and along the wing to the fuselage, and epoxy F19 in place. For this step, remember, measure twice, glue once, and take care not to glue the dowels, too!
13. Do not anchor the trailing edge yet; remove the wing and set it aside.



- 14. Sheet the opening between F1A and F2A, remove the assembly from the board, sand smooth, and set it right side up.
- 15. Glue F2B through F8B balsa formers in place, and glue F1B ply former in place, making sure it is level and even with F1A.
- 16. Glue  $\frac{1}{4} \times \frac{1}{4}$  balsa stock in the top notch in the formers as a keel support.



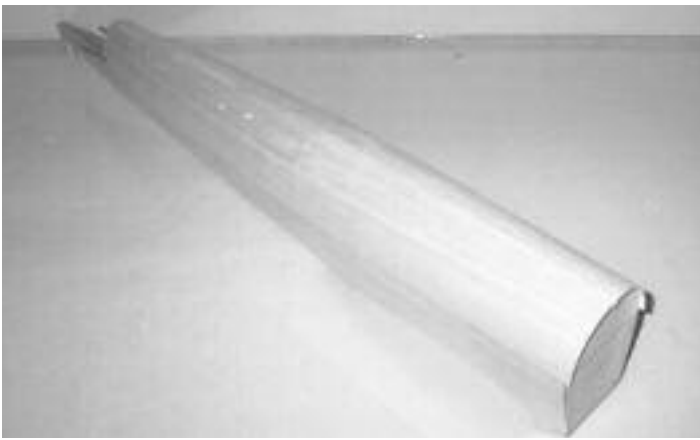
- 17. Cut a red 48" pushrod housing into two 24" pieces, and slide the pieces through the pushrod holes in the formers. The right side pushrod housing (for the elevator) may be placed  $\frac{1}{2}$ " ahead of the left side. Place the left side pushrod housing flush with F4B. Glue the housings in place.



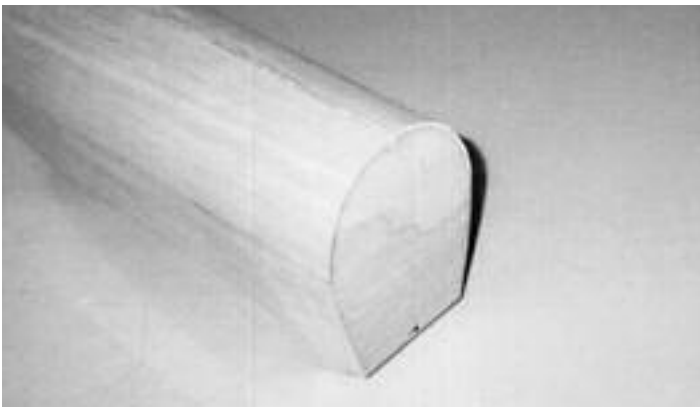
- 18. Working alternately side to side, glue  $\frac{1}{8} \times \frac{1}{4}$  balsa stringers in the notches in F1B through F8B.
- 19. Glue the F11 Cockpit Floor in place, resting on the stringers.
- 20. Sand the keel support and stringers flush with F8B. Sand the stringers only flush with F1B. Lightly sand the assembly smooth.



- 21. Using the same techniques as with the bottom of the fuselage, sheet the top of the fuselage. The top of the fuselage has too great a compound curve for continuous sheeting, so after gluing to sheeting up to the second row of stringers (even wet, there will be a radical wave in the sheeting), at F5B, carefully cut the sheeting as shown. This will allow you to continue sheeting the back half of the fuselage.



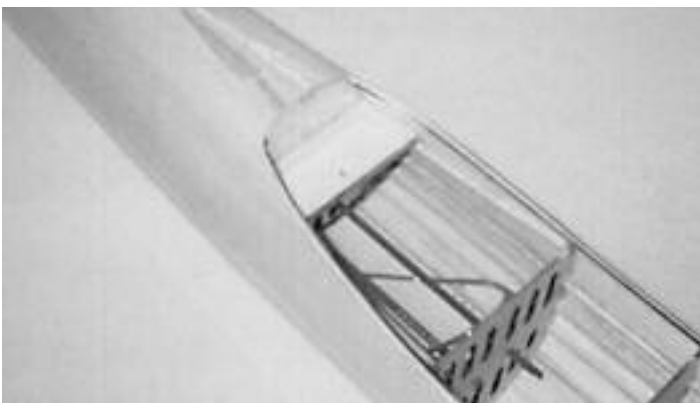
- 22. Carefully sand the sheeting at the cut you made to fit flush when laid down. Remembering to keep the sheeting damp, continue with sheeting the front half of the fuselage. Leave at least 1/8" of sheeting in front of F1B.



- 23. Bevel the bottom edge of F9 and sand F9 to fit to the front of the fuselage. Epoxy in place.

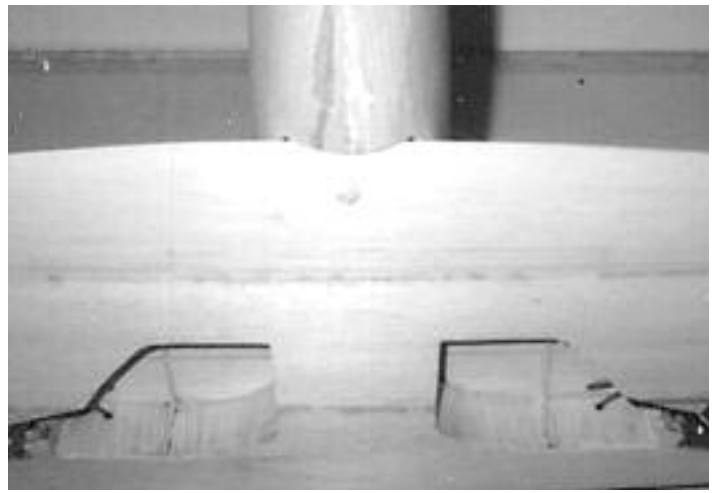
24. Sand the sheeting and keel supports flush with F9.

25. Sand the fuselage smooth and use lightweight filler to fill any gaps.



- 26. Measure the distance from the trailing edge of the wing to the pilot hole you drilled. Using the center of F18 as a reference point, mark the location for F18, sand for a snug fit and epoxy in place. Note that F18 rests on the first set of stringers.

27. Place the wing in the saddle and center the wing. Mark its location in reference to the fuselage.



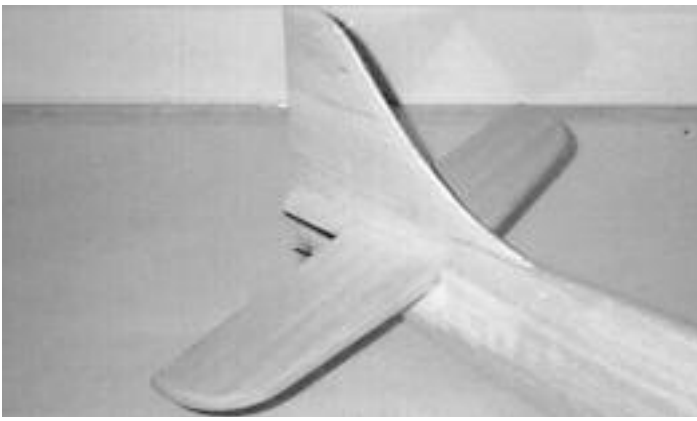
- 28. Holding the wing to the fuselage securely, using the pilot hole in the wing as a guide, drill the hole through the wing and F18 to locate the wing hold-down bolt.

29. Cut the threads for the bolt in F18, and enlarge the hole in the wing to allow the bolt to pass through.



- 30. Check the plans and stabilizers for the approximate pushrod location. Drill or bore holes in the F13s to properly locate the pushrod housings.

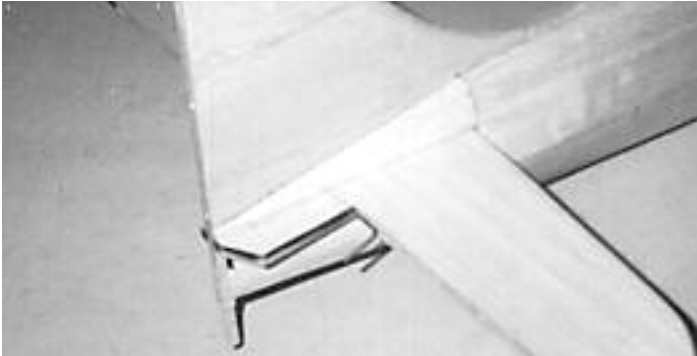
31. Glue F13s in place. Note that F13 lines up with the sheeting, not the 1/4 x 1/4 longeron. Use the slots in the horizontal stabilizer as a guide.



32. Sand F13s to shape. Fill in any gaps with light-weight filler.

33. Place the horizontal stabilizer on the fuselage, sliding the tabs on F13 into the slots. Check the stabilizer for alignment with the fuselage and level with the wing. Mark its location and epoxy in place.

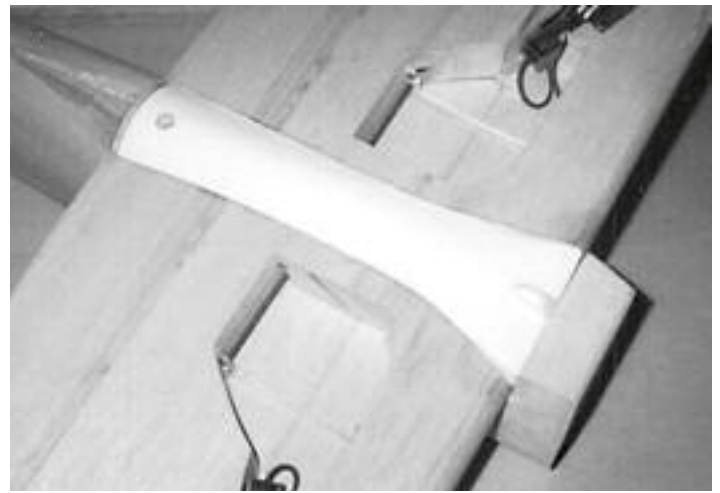
34. Glue the vertical stabilizer in place.



35. Sand and shape the F14 balsa blocks as shown in Figure 55 to fill the area between the horizontal and vertical stabilizers. It will be helpful to hollow out the blocks after shaping for balancing purposes (remember, one extra ounce in the tail requires three ounces in the nose to balance!). Glue F14s in place.



36. Trial fit the F15 balsa Tail Block in place. Sand it to fit between F8A and the fin post first. Place the rudder in position and mark the bottom of the tail block. Sand the flat surface of F15 until it matches the mark for the rudder. This will ensure the proper shape for the aft end of the fuselage. Glue F15 in place and sand to match the fuselage contours.



37. Cut the plastic belly pan to shape and trial fit it to the wing. Sand for a good fit.

38. Glue a piece of scrap 1/4" balsa to the trailing edge of the wing and sand to the fuselage shape.

39. Locate the hole for the wing holddown bolt and pre-drill a pilot hole. Glue the belly pan to the wing.

40. Open up the hole for the wing holddown bolt enough to remove the bolt.



41. If you wish to open up the cockpit area, carefully cut the top sheeting along the center of the fuselage to expose an opening just aft of F4B. Using the Cockpit Cutout guide provided on the plans, mark the area to be removed and cut the sheeting away.

42. Glue F16 and F18 in place as shown on the plans.

43. Glue F17 in place, aligning it on the fuselage so as to line up with the bottom of the trailing edge of the wing.

44. Cut and shape the plastic wing fillet to match F17, the wing chord, and the contour of the fuselage. Glue the wing fillet in place. Repeat for the other side.

45. Cut three 1/2" pieces from the 3/8" maple blocks to form the cowl mounting pads. Glue to the firewall.

**Hint:**

The screw holes in the cowl will be the first part of the cowl to break. To prevent this, locate the position for the screws. Then glue small squares of thin aluminum or carbon fiber to the inside of the cowl in the screw locations. This will provide extra support for the cowl in these areas. Although not required, fiberglassing the inside of the cowl is recommended to increase it's strength.

46. Locate and drill the holes for the cowl and mount in place.

## **Final Assembly**

The remainder of the construction consists of attaching the rest of the components to the airplane. Most of this is builder's choice, and individual tastes, styles, and component selection, so any detailed descriptions would be impossible. The remainder of assembly is described in general terms only.

### **Engine Installation**

Locate the center of the firewall and mark for the motor mount. The firewall is set at 0 degrees (no right thrust). If you wish to add right thrust (larger engines might need this) offset the motor mount location as necessary to keep the spinner location correct and add washers behind the left side of the mount. Mount the engine and locate the throttle pushrod location.

### **Servo and receiver installation**

3/8 maple blocks are provided for servo rails. Mount these as shown on the plans and mount the servos. Mount the receiver and connect the components.

### **Covering**

Cover the airplane with the covering of your choice. The covering choices are too numerous to mention, but the airplane shown on the box was covered with film, painted, and clear-coated. It is recommended that the airplane and control surfaces be covered separately.

### **Cockpit and canopy**

Finish the cockpit to the level of detail you desire. The instrument panel on the three-view may be cut out and glued in place. Several 1/9th scale pilot figures are available. Glue the canopy in place and paint the canopy bows to match your airplane.

### **Control surfaces**

Locate the bellcrank positions. Fill the open bays in the control surfaces with scrap balsa to provide support for the bellcrank, and sand to shape. Final sand the control surfaces. Locate the hinge points (hinges and other hardware are not provided in the kit because everyone has his own preferences. Rather than put in stuff that most of you will throw away, we left it out to keep the kit price down) and install the hinges and control surfaces. Use at least three hinges per control surface for best results. Connect and adjust the pushrods.

### **Fuel Tank and Throttle Cable**

After deciding which direction the engine will point (up, down, or sideways) drill holes for and install the throttle cable. Mount the fuel tank of your choice, and connect the lines.

### **Landing Gear (Fixed)**

If you use the tailwheel wire provided, mount it during rudder installation. Insert the main gear wire legs into the slots in the wings, secure with straps, and mount the wheels of your choice. The Ply gear doors may be installed at this time. Landing gear (Retracts): Bend the gear wire to match the angle shown on the plans, and install the gear legs and wheels. Install the remainder of the retract components per the retract instructions.

### **Control Throws:**

Ailerons: 7/16" up & down  
Elevator: 7/16" up & down  
Rudder: 3/4" left & right

The rest is up to you! Fly and enjoy!