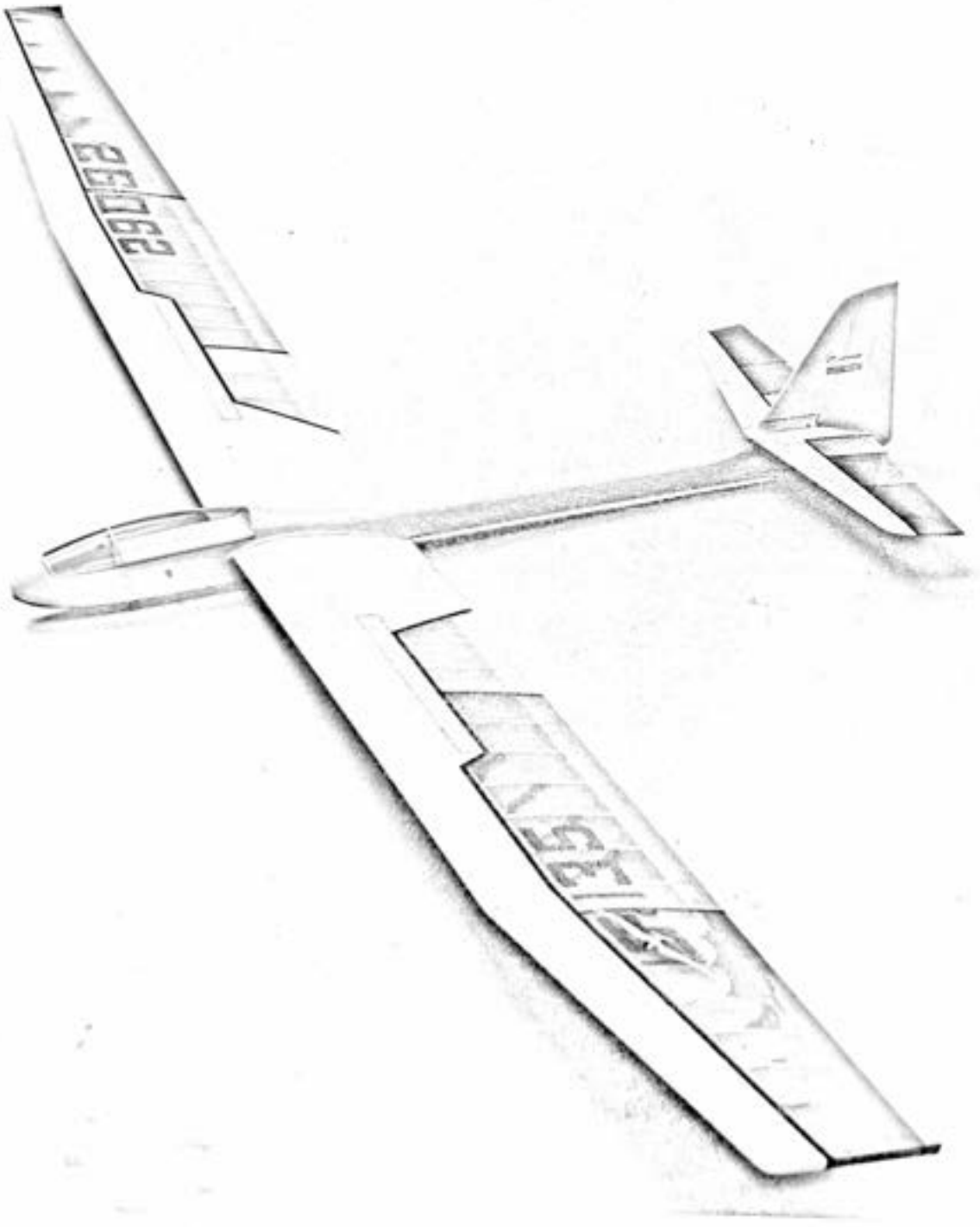
BUILDING INSTRUCTIONS FOR

AIRTRONICS

AQUILA GRANDE'

UNLIMITED CLASS R/C SAIL PLANE



INTRODUCTION

The Grande' was developed from the World Champion Aquila. Since the introduction of the Aquila in 1975, it has been the dominant design in standard class competition. We believe that the Grande' will establish a similar record in unlimited class competition.

The major changes from the Aquila are an increased wingspan, with higher aspect ratio, and a new wing airfoil. The airfoil is a 10% thick, semi-symmetrical section, with significant Phillips entry and moderate leading edge radius. It is a development of the modified Aquila airfoil used by Skip Miller in winning the 1977 World Soaring Championship. The tip panels incorporate a changing section which provides built-in washout to reduce tip-stall tendencies.

There are significant structural changes from the Aquila. The most obvious is the use of an epoxy-glass fuselage for ease in building and greater strength. The wing has been beefed up with a 50% increase in spar cross sectional area. The bottom leading edge is sheeted back to the spar to form a complete D-Tube. This increases bending strength and torsional rigidity. The stabilator has been stiffened considerably by addition of sheet from the high point forward. This was done after two of the prototypes developed stab flutter during speed runs. The vertical tail is larger than the Aquila and has more area behind the hinge line for improved dynamic balance.

There are numerous design refinements incorporated into the Grande'. Locking screws are used for positive retention of the stabilator panels. A large ballast compartment has been built into the fuselage, with easy access through the canopy opening. The main wing joiner is 5/16 dia. music wire to reduce wing deflection under launch stress. Solid push rods are used to reduce tail flutter and for improved control response. The Aquila spoiler system is unchanged as we have not found any other method which works as well, without increased weight and complexity. Polyhedral angles have been increased for improved turn response and additional stability.

The Grande' was designed for FAI class 3-B and general AMA competition. It is an L/D airplane which has excellent speed range and penetration. With a little down elevator it will accelerate quickly and really move out. Slight up trim will slow the ship up to hang onto marginal lift. The Grande' is definitely not a floater – you've got to keep the speed up to realize the performance potential of this design.

I would like to thank all the modelers who built and flew prototype models to prove the design. In particular, Bill Davidson, Don Edberg, Jack Hiner and Skip Miller who contributed greatly. Special thanks to my son, Tim, for his advice and encouragement during the design phase.

The excellent instructions and photos are the handiwork of Al Doig, of the Torrey Pines Gulls. Thanks for your help, Al.

Lee Renaud

BUILDING NOTES

Some of the building techniques described in the instructions are of a personal preference nature. For instance, I like to trim pieces to length and shape as I go. If you prefer to let it hang over and trim after assembly, that's your choice.

In general, if the dimensions of a part are given, that part is precut and can be found in one of the bags. Otherwise you will be told to trim to fit. The parts in the bags have been separated by function, wing, fuselage, etc.

A word about adhesives; the term "glue" refers to Aliphatic Resin glues such as Titebond, Elmer's, Wilhold, etc. You may substitute 5-minute epoxy to speed certain steps. If epoxy is required, it will be specified.

Building sequence is important in some areas. I like to start with the wing because you use up all the big pieces of wood and won't wind up trying to sheet a three foot wing section and have only six 6" pieces left. Which is what will happen if you don't cut the outer panel sheeting first, like it says. I don't want to tell all you twenty-five year veterans how to do it, but why don't you relax and leave the driving to us. It's reasonably safe to follow the instructions. After starting the center wing panels it is certainly safe to jump ahead and build the outer panels, or tailfeathers whilst things are drying.

During the fuselage assembly it may seem that we move on to the next thing without finishing the last. What we are doing is temporarily fitting the wings and tail to assure they are aligned correctly. We then start aft and work forward affixing things permanently. It is a tight squeeze installing things way back in a glass fuselage and the fewer things in the way the better.

The method described for wing to fuselage alignment and affixing root ribs in place will give a keen fit without a lot of later agony. But remember one thing in the initial wing building phase – alignment of root rib W1 to the wing is key to proper wing alignment.

SECTION I

WING ASSEMBLY

1. Thumbtack or tape the left-hand wing drawing to your building board and cover with wax paper.

2. Note, that of the twelve sheets of 1/16" x 3" x 36" balsa, eight are of light density, suitable for leading edge sheeting, the four remaining are of firmer stock, suitable for the trailing edges. Select 4 pieces of the light density stock for upper and lower leading edge sheeting for the tip panels. Trim to 23-3/8". Taper these four pieces from 2-1/4" at one end to 2-7/8" at the other. The four cut off pieces 12-5/8" long, are for sheeting the top center panels, inboard of the spoiler bays. Select two pieces of the firmer stock, trim to 24" long. Save the 12" pieces for lower center panel sheeting as needed. Strip the two 24" sheets into four pieces, tapering from 1" to 1-3/8". These are the tip panel trailing edges. Set aside with the prepared tip panel leading edge sheeting.

3. Lay a 3' straight edge along one side of each of the four remaining pieces of leading edge sheeting. If it is not straight, use the straight edge as a guide to trim a small amount from one edge of the sheet. Do not trim the other edge. This "trimmed" edge will be placed on the center line of the spar. This is the upper and lower leading edge sheeting for the center panels.

4. Trim one edge of each of the two remaining sheets of trailing edge sheeting then strip into four 1-3/8" x 36" trailing

edges. Set two aside for upper trailing edges. Using a sanding block, taper the rear of the two lower trailing edges as shown on sheet 2 of the drawing. Pin one in position.

5. Pin the lower leading edge sheet in place with the trimmed edge to the rear. Note that the rear edge is on the center line of the spar. Let the ends extend beyond the root and outboard end for now.

6. From 1/16" x 3" x 12" balsa sheet, trim the bottom inboard sheeting to shape. Forget the triangular plywood gusset for now. Leave the inboard end a little long for trimming. Make sure to trim the outboard end to the bottom sheeting trim line (dotted line on the LH drawing). Glue and pin in position. Lay a straight edge across the W1 inboard "tic" marks and trim the ends exactly to length. This will aid in accurately locating W1. We also like to trim the outboard ends of the sheeting to length at this time.

7. Position the 1/16" triangular plywood gusset with the apex on the spar center line, the base flush with the root sheeting line and lined up with the locating tic marks. Using the gusset as a pattern, cut out the bottom sheeting and glue the gusset in place.

8. Trim, glue and pin into place the 1/16" x 1/4" lower cap strips except the one at W5.

9. Trim a 1/8" x 3/8" x 36" piece of hardwood spar stock to length. Measure 3" from the inboard end and glue one of the 3/8" x 9/16" x 6-1/2" balsa spar fillers to the spar with the angled end inboard, right side up. Glue one 3/8" x 9/16" x 2-7/8" outboard spar filler flush with the outboard end of the spar. Also note the angle on one end of this filler and put the angle end outboard, right side up. (These spar fillers may be glued to the spar after it is in place if care is taken to properly clamp them and excess glue is wiped off.)

10. Glue and pin spar assembly in place. Make sure the spar is aligned over the drawing and is **straight.**

11. Modify fourteen of the twenty-six W4 wing ribs as shown on sheet 2 of the drawings. The spoiler cable notch in the front of the W1, W2, W3 ribs may be made more easily if these fifteen (including W1) ribs are left pinned in a stack.

12. We will now start installing ribs. **DO NOT GLUE RIBS TO THE BOTTOM LEADING EDGE SHEETING FORWARD OF THE MAIN SPAR!** This will be done at a later step. Glue and pin the outboard W4 rib in place.

13. Working inboard, using a balsa shear web to measure spacing, install the six W4 ribs and their 1/16" x 3/16" x 2-13/16" trailing edge balsa webs.

14. Glue and pin rib W1 in place using plywood shear web W14 to set the proper rib angle. Do not glue W1 forward of the main spar. **Pay particular attention to aligning W1 to the drawing. This will affect the wing to fuselage fit and alignment.** Leave W14 to hold the dihedral angle until W1 is dry.

15. Glue the top main spar in place making sure the ribs are square and the spar is flush with the tops of the ribs.

16. Using 15 or 45-minute formula, epoxy the forward plywood web, W14, in place. **Do not install aft web W15.**

17. Again using a balsa shear web for spacing, install only the aft section of ribs W3 as well as the trailing edge balsa webs between them. Do not install the forward sections of ribs W3 at this time.

18. Using the piece of 1/4" x 1" x 36" trailing edge stock (spoiler blade material) as a wedge, block up the front of the lower leading edge sheet until it is snug against the ribs. Using a cyanocrylate adhesive such as Hot Stuff, Zap, etc. fasten ribs W4 and W1 to the sheeting. Make absolutely sure the ribs are fully in contact with the sheeting, not only so the adhesive will stick, but also to form the proper leading edge contour.

19. Sight down the leading edge of the ribs and make sure the sheeting is straight in the area of ribs W2 and W3. Install these ribs in the same manner as step 18, also fasten them to the plywood shear web W14.

20. Glue and pin the shaped hardwood leading edge in place. run a fillet of glue around the forward section of all ribs.

21. Trim the 1/4" x 3/8" x 1" hardwood rear alignment pin block to shape and glue in place.

22. Next, install the 1/16" x 13/16" x 2-3/4" vertical-grain balsa shear webs except those in the outboard bay. Use plenty of glue and make sure they are tight against the spars. The shear webs are a major source of wing strength.

23. To install the spoiler cable tubing, drill a 1/8" hole in the shear webs as shown on drawing sheet 2, Section B-B. Clean out any obstructions in the leading edge notches of ribs W1, W2 and W3. Thread the 1/8" clear tubing through the holes into position. Cut off the tubing and fix into place with a dab of 5-minute epoxy at each rib.

The left hand wing panel may now be removed from the work surface and the right hand panel constructed in the same manner.

JOINING THE WINGS

24. Carefully block-sand rib W1 flat to remove any protuberance.

25. Temporarily tack glue plywood root rib to W1 on both panels. Make sure hole for main joiner tube is right against plywood shear web and the top spar. Sharpen one end of both 11/32" O.D. x 3" brass wing joiner tubes by tapering the inside to a sharp cutting edge with a needle file or X-Acto knife. Use the tubing to hand-drill a hole through W1 of both panels as shown on drawing sheet 2 Section A-A. Now use the tubing, cookie-cutter style, to cut a plug from a piece of scrap 1/16" sheet balsa. Leave these plugs in the tubing ends and secure with a little 5-minute epoxy. This will keep the epoxy out of the tubing during assembly. Clean the outside of the tubing with sandpaper.

26. The fuselage has dimples to locate the main wing rod, wing alignment pin, stabilator hinge tube and spoiler cable egress. With a sharp scribe, carefully indent the exact center of these dimples. Now, **carefully** drill a 1/16" hole through each. Enlarge all holes except the rear alignment pin to 1/8" with a drill. Put a piece of 1/8" music wire through the stabilator hinge holes and another through the wing joiner holes. Sight down the fuselage to make sure the wing and stab wires are on the same plane. Now measure the angle between the wing rod and the fuselage wing root fillet to make sure the holes are drilled square with the fuselage center line. If any misalignment is detected, pull the holes slightly with a round needle file to correct alignment. Now, carefully enlarge the main wing joiner holes, one drill size at a time to 5/16". Install 5/16" wing rod and recheck alignment.

27. When epoxying the wing joiner tubes into the wing, much later agony is saved if we do it while the wings are in correct position on the fuselage. Block up two building boards which are at least 10" wide and 3' long, a minimum of 1-1/2" above a long flat surface (four 2 x 4's will work well as blocks). Space the ends far enough apart to receive the fuselage. Sight down the boards and shim until they are in the same plane. Put the 5/16" wing rod through the fuselage and nest it in the slot between the two boards. Slide the boards tightly against the wing root fillets.

28. Slip the wing joiner tubes, plugged end first, into the wings and slide the wings onto the wing rod. **Inboard end of wing joiner should extend through both W1 and plywood root ribs.** Block the wing panels up until the end is 2-1/2" above the surface. Block the rear of the fuselage until plywood root rib aligns with the fuselage fillet. If the wing root does not rest freely on the work surface, file the hole in W1 slightly or file a small flat on the end of the tubing. Check that both tubes are properly and equally positioned in their respective cavities. When satisfied with the fit, epoxy both ends of the tubes in position using enough 5-minute epoxy to

hold it securely, but not so much that the spruce wedges shown in Section A-A, Sheet 2, can't be installed. Quickly put the assembly back in the jig and check that the root is flat on the surface. Root rib is snug against the fuselage fillet and the panel ends are still 2-1/2" above the work surface. Do not disturb until the epoxy is well cured.

29. Carefully slide the wings off the wing rod. Cut the wedges shown in Section A-A from 1/4" x 3/8" x 12" spruce. Mix some 45-minute epoxy and generously coat the inside of the cavity. Push in the wedges. Let the epoxy settle and work it into all the crevices. Add more epoxy if necessary. When the cavity seems full, Epoxy plywood web W15 in place. Wipe off excess epoxy, clamp and let it cure. Carefully remove plywood root ribs from W1 and set aside.

OUTER WING PANELS

30. Using a sanding block, taper the rear edge of one of the trailing edge pieces (these were previously cut and set aside). Pin over the left outer panel drawing and trim to length.

31. Pin the lower leading edge sheeting to the drawing with the rear edge on the spar center line and trim to length. Do not shim the leading edge as shown on the drawing. This will be done later.

32. Trim and glue the 1/16" x 1/4" lower cap strips in place except the one at W5.

33. The outboard panel tapers in thickness so the 3/8" x 9/16" x 2-7/8" balsa spar filler must also be tapered. Identify the end with the 4^{0} polyhedral angle cut and mark the other end to the exact height between the spar notches of rib W6. Sand the filler to this slight taper.

34. Trim one of the 1/8" x 3/8" x 24" hardwood spars to length. Glue the spar filler flush with the inboard end, with the angle-cut inboard.

35. Glue and pin the lower spar assembly in place making sure it is straight.

36. Glue and pin rib W6 in place. **Do not glue any of the ribs forward of the spar.**

37. Working outboard, using a shear web for spacing, install the remaining ribs as well as the balsa trailing edge webs.

38. Glue the upper spar in place, clamping it securely to the spar filler. Make absolutely sure the spar is flush with the tops of the ribs.

39. Using the spoiler trailing edge stock again, shim up the front of the lower leading edge sheeting as specified on Sheet 3 of the plans. This will build in the proper amount of washout. Fasten the ribs to the sheeting with cyanocrylate adhesive such as Hot Stuff, Zap, etc. Make absolutely sure the rib is fully in contact with the sheeting.

40. Trim a 24" piece of shaped hardwood leading edge stock to length. Glue and pin in place. Make sure that the sheeting makes good contact with the shaped leading edge.

41. Install the shear webs except those between ribs W5 and W6. Note that while the forward webs continue all the way to the tip, the aft webs stop at rib W9.

The outer wing panel may be removed from the building board when the glue is dry. Following the same procedure, make a right hand outer panel.

42. Trim and sand the trailing edge webs flush with the top of the ribs on both center and outer panels. Trim the outer panel shear webs flush with the spar and sand down any other projections above the spars on all panels. Trim the lower leading edge sheeting flush with the hardwood leading edge.

JOINING THE INNER AND OUTER PANELS

43. Pin one wing center section to the building board. Block up the mating tip so that rib W13 is 3-3/4" above the surface. Dress the mating ends of each with a sandpaper block until a good fit is obtained. Trim the 1/8" x 1/4" x 3" spruce leading-edge-tie to fit as shown on drawing Sheet 2. Mix some 5-minute epoxy, apply to the mating ends and place the outer panel in position. Coat the two W16 dihedral braces and their mating surfaces with epoxy and clamp in position. Epoxy the leading edge tie piece to the leading edge and pin everything down making sure all sheeting is lined up.

44. Cut rib W5 to length (same as W2). Trim to clear leading edge tie. Glue front and rear sections in place. Add the shear webs and trailing edge webs.

45. Glue the aft sections of ribs W2 in position. Add trailing edge webs.

46. Glue in the 1/8" x 3/8" x 24" spruce sub-spar to center section and add sub-spar shear webs as shown on Sheet 2 of drawings.

47. Trim the trailing edge webs, which were just installed, flush with the tops of the ribs. Trim the 1/16" x 1-3/8" x 36" trailing edge (which was previously cut), to length. Using 15 or 45-minute epoxy, fasten the upper trailing edge in place. Do not use a water base glue here because of the possibility of warping the trailing edge.

48. Trim the outboard end of the 1/16" x 3" x 36" balsa leading edge sheet and locate on the center of rib W5. Glue the sheet in place and pin tightly. Be sure that the trimmed edge (step 3) is centered on the top main spar.

49. Add the inboard planking as shown on drawing Sheet 2 using the prepared 1/16" x 3" x 12-5/8" balsa. Observe the outline just inboard of the spoiler bay. Plank around the spoiler bay with 1/16" x 1/4" cap strip stock.

50. Trim, pin and glue the 1/16" x 1/4" balsa cap strips except the one on W5.

51. After all adhesives have cured, remove from the building board. Pin the outer panel to the building board, supporting the inner panel with a block. Shim the leading edge of the outer panel as shown on drawing Sheet 3. This will protect against warpage when adding top sheeting. Trim the trailing edge material to a proper fit. Epoxy in place using 15 or 45-minute epoxy. Trim and glue the leading edge sheeting into place. Work carefully here to insure a good fit on W5. Add the cap strips including the one on W5. Allow adhesives to cure and remove from the building board. Trim, glue and pin the cap strip on the bottom of rib W5.

52. Epoxy the wing tips in place, flush with the lower edge of rib W13. Form the soft steel wire (shown on Sheet 2) to shape, notch the trailing edge and epoxy to the rear of the tip. Cut the 1/4" x 1/4" x 2" balsa in half to make the screw-eye support for the spoiler cable turn-around. Install the screw-eye and glue in place on the sub spar as shown on drawing Sheet 2.

53. Trim the 1/4" x 1" x 36" trailing edge stock to fit the spoiler bay, leaving a 1/32" gap all around the blade, Sand smooth. Trim the ribs to provide clearance for the blade with the upper blade surface flush with the upper wing surface. (A small piece cut from the blade material makes a good pattern to trim to.) Glue 1/8" sq. balsa strips to W3 and W4 to support the blade ends as shown on the drawing. Sand flush with the upper wing surface. Epoxy the control horn to the bottom of the spoilers as shown on the drawing, noting that the horn projects 1/4" forward of the blade leading edge and that a right and left hand blade is required. (The control horn installation may be left until the spoiler blade has been Monocoated, which simplifies this operation.)

54. Carve the wing tips and sand the leading edges to shape. Pay particular attention to the shape of the leading edge. This will have a noticeable effect on the flying characteristics of the sailplane. Carefully sand the wing smooth. However, leave the area of the root rib unsanded until the plywood root rib is on, which comes later. This completes the basic wing structure.

SECTION II

STABILATOR

1. Fasten the drawing to the building board and cover with wax paper.
2. Trim four leading edge sheets from 1/8" x 3" x 13" balsa as shown on the drawing.
3. Select the two hardest pieces of 3/16" x 1/4" x 36" balsa and cut to make leading edges. Laminate with glue, wipe off excess glue and pin to the drawing.
4. Trim the tips from the 3/16" x 3/4" x 18" balsa. Cut the rest of the 3/16" x 1/4" framing pieces. Pin and glue all parts in place.
5. Trim the 1/8" x 3/16" spruce spars and glue in position.
6. Cut the 3/32" x 3/16" balsa ribs to fit and glue in place.
7. Glue and pin the 1/8" balsa leading edge sheeting, which you cut in step 2.
8. Cut the 1/8" x 3" x 10" balsa sheet into two 1-1/2" x 10" pieces. Cut them to shape for the inboard rear sheeting. Glue and pin in place.
9. When the assembly is dry, remove from the building board. Trim the inboard sheeting flush with the ribs. Note where the wheel collars are located. It will be handy to know when the drawing is covered with stab. Turn over, reverse the stabs and re-pin to the board. Shim the outboard rear edge with scrap 1/8" balsa.

To properly align the brass hinge tubes in the stabilator we will make a jig using the Airtronics Stabilator Horn. If you have built a standard Aquila, the procedure is exactly the same except for the wheel collars. These collars will clamp the stab to the hinge wire to prevent its slipping out.

10. Cut two 1-1/2" pieces of brass tubing from the 1/8" O.D. stock. File and deburr the cut ends.
11. Take another 4" length of 1/8" O.D. brass tubing and position the two wheel collars an equal distance each side of center and spaced 1-1/8" apart. Check the spacing by laying the assembly in position on your stab (the exact dimension doesn't matter just as long as the collars are snug against the inside of the root rib). Mark the positions on the tubing by tightening the screws down hard a couple of times. Make sure the screws are pointing in the same direction. With a round needle file, cut two notches all the way through the tubing so the collar screws can tighten against the joiner wire. Deburr the hole and clear the tube by running a 3/32" joiner wire through it.
12. Slip the notched tubing through the forward hole in the stabilator horn. Clamp the collars in place with their screws through the holes. Use the Allen wrench provided to make sure they are both pointing in the same direction. Slip one of the 3/32" joiner wires through the rear hole in the horn. Slip one of the pieces of tubing cut in step 10 on each side of the hinge wire and we have our locating jig.
13. Using the center line on the drawing, mark the position of the rear tubing and notch the ribs in four places to receive the tubing. Cut the notches deep enough so the 1/8" tubes are below the rib surface. Using the jib, cut the forward notches. The sheeting must be carved out in the area of the collars to permit the tubes to nest in the notches. When satisfied with the fit, rough the tubing a bit with sandpaper and epoxy the tubes and collars (with the screws pointing up) in position. Be careful not to get epoxy on the collar screws. When the epoxy is set, crimp the outboard ends of the four tubes to prevent the joiner wires from slipping through.
14. Carve a clearance notch in the leading edge sheeting for the collar and file an access hole for the screw. Glue and pin the sheeting in place. Trim the inboard rear sheeting and glue and pin in place.
15. When the assembly is dry, remove from the building board and with a razor saw cut the forward brass tubing flush with the root rib.
16. Trim the stabilator to the drawing outline and sand to the airfoil shown on the drawing.

This completes the stabilator structure.

SECTION III

RUDDER

1. Strip the 1/8" x 1" x 10-1/2" balsa sheet into two rudder spars tapering from 3/4" to 1/4".
2. Frame the rudder using 3/16" x 1/4" balsa and 3/16" x 3/4" strip trimmed for upper and lower formers. Glue and pin in place.
3. Trim and glue the 3/32" x 3/16" balsa ribs in position.
4. Glue and pin the 1/8" balsa spars from step 1. Laminate 1/8" x 1/4" balsa fairings to the rudder as shown on the drawing. Allow the glue to dry and remove from the board.
5. Glue the right side balsa spar into position and laminate the 1/8" x 1/4" pieces. Allow to dry and sand to the airfoil shown in Section E-E, Sheet 3. Shape and sand forward fairings to match the shape of adjacent fuselage section.

This completes the rudder structure.

SECTION IV

FUSELAGE

Do not sand the outside of the fuselage until ready for paint. It is necessary to maintain transparency to locate internal parts. Clean inside of fuselage thoroughly with acetone before installing any internal structure. Use only epoxy to bond parts to the fiberglass fuselage.

1. Scribe the fuselage in the canopy area to the 1/4" wide deck and the forward trim line as shown on Sheet 1 of the drawing. Mark the rudder push rod exit in the tail section. Neatly trim these to shape as well as the access hole in the top of the fin and the slot in the fin for the aft stabilator joiner wire. (Both are pre-marked in the fiberglass.)
2. Cut out fuselage bottom to accept towhook bracket. Use molded lines on fuselage as guides, and trim until bracket fits in with a small amount of clearance all around. Center towhook bracket on 1/8" x 3/4" x 4-1/8" plywood towhook support and drill two 7/64" holes using the towhook bracket as a guide. Re-drill holes in the plywood support to 5/32" and epoxy two 4-40 blind nuts on one side. Mount bracket to plywood support using two 4-40 x 1/2" round head screws and washers. Apply epoxy to plywood support taking care not to epoxy towhook bracket to plywood. Install assembly inside of fuselage, hold securely until epoxy sets. Remove bracket from fuselage (to be reinstalled after painting).
3. Epoxy the 1/16" x 5/16" x 5/8" plywood stabilator hinge

pads to the inside of the fin as shown on drawing Sheet 1. Carefully re-drill the 1/8" holes through the pads.

4. Carefully ream the wing joiner holes to 11/32" to fit the brass tubing. Round the leading edges of the four plywood root ribs. Rough up the fuselage wing root with sandpaper. Apply a light coat of Vaseline to the ends of the 11/32" tubing and put it temporarily in the fuselage to locate the root rib. 5-minute epoxy the plywood ribs to the fuselage, one at a time, slipping them over the 11/32" tubing. Carefully align the trailing edge of rib with fuselage and hold firmly in place until the epoxy sets. Remove the tube before the epoxy is completely cured so it won't stick.

5. To epoxy the plywood root ribs onto the wings, put the brass wing joiner tube and the wing joiner rod through the fuselage. Drill out the spoiler cable holes in the ribs to 3/16". Lightly coat one wing root and rib with 5-minute epoxy and stick the rib in place. Slide the wing onto the joiner and carefully line up the trailing edge. Hold the wing tightly in place against the fuselage until the epoxy sets. Make sure the trailing edges stay in line. This will give a perfect fit. Repeat with the other wing. Sand the wing sheeting to fair with the plywood root ribs.

6. Slip one wing panel on the wing joiner and, using a 1/8" or No. 30 extension drill (or a sharpened piece of 1/8" tubing), line drill the rear alignment pin hole into the wing, through the fuselage while holding the wing root in place. The hole should correspond to the 1/8" pilot hole already in the wing root ribs and should be drilled 1" deep. Repeat for the other wing.

7. Cut two 1" pieces from one of the 4" brass tubing. Deburr the ends, clean with sandpaper and epoxy into the wing root rear alignment pin holes.

8. Cut the 1/4" dowel to length as rudder and elevator push rods. Drill 1/16" holes to a depth of 1" in each end of both tubes. Bend and trim the 1/16" x 8" music wire to the shape of the aft push rod ends. With a triangular or square needle file, make quite a few shallow notches in the forward end of each for the epoxy to grab onto. Clean with lacquer thinner or alcohol. Force 5-minute epoxy into the holes, lightly coat the ends of the rods, insert and wipe off excess epoxy. Do not install the forward 1/16" wire push rods. These will be installed during radio assembly.

9. Cut a piece of 1/8" brass tubing 1-1/16" long. Roughen the outside with sandpaper. Temporarily put this stabilator hinge tube through the fin. Use two 3/32" joiner wires to install the stabilator. Tape it in place to prevent movement. Install the wings. Sight from both front and rear to check that the stabilator is not canted with respect to the wing. If it should happen to be out of line, file the 1/8" hinge hole in the fin to correct. When alignment has been achieved, put a little 5-minute epoxy in the unfiled side of the hole to support the tube while the rudder is being fitted. (Don't epoxy the tube in place yet.)

10. Hold a square on top of the stabilator and a straight edge up the rudder hinge line of the fuselage fin. (You may need help if you don't have three hands.) When the straight edge is exactly at right angle to the stabilator, mark the hinge line on the fuselage with a felt-tip pen or scribe. Cut slots for the rudder hinges as shown on the drawing. This can easily be done with a Dremel Tool using the No. 409 thin grinding blades. Trim the top hinge to clear the stabilator joiner rod. Slot the rudder for the hinge and temporarily install the rudder on the fin. Again check that the rudder is square with the stabilator. If it is not, the rudder can be tilted by slightly enlarging the lower slot. When it looks square, mix up some 5-minute epoxy, pull out the bottom hinge and put epoxy in the fin slot and on the hinge. Put the rudder back on. With a square on the stabilator, again line up the rudder and then hold the assembly still until the epoxy cures. Now, epoxy the other two hinges to the fin and rudder. Reach through the top access hole and smear epoxy on the hinge tabs inside the fin. Liberally epoxy the rudder hinge from the backside. Sharpen the end of the long 3/32" joiner wire and, with the rudder in place, push it up into the bottom of the fin. Enlarge this hole to 1/8". Cut a piece of 1/8" brass tubing to 3/8" length and epoxy it into the hole for the upper rudder hinge. Make triangular gusset from 3/16" x 3/4" balsa scrap. Notch for upper rudder hinge tube and epoxy to rudder as shown on Sheet 3.

11. Assemble the stabilator horn to the elevator push rod (made in step 7) using the Snap-R-Keeper. Do it carefully because it will be installed where you can't reach it. Push the stabilator horn through the fuselage (correctly oriented) back to the fin. Work it up into position and push the 1/8" x 1-1/16" brass tube through the hinge holes in the fin and the hinge hole in the horn. Assemble the stabilator to the hinge using the two 3/32" joiner wires. Carefully work the stab with the push rod, looking for any binding. Make sure the rear joiner clears the slot in the fin. When satisfied, epoxy the brass hinge tube in place by reaching through the top access hole. Don't get any epoxy on the horn but confine it to the plywood pad area. Let the epoxy cure and file the tubing flush with the fin fairing.

12. Clean the outside of the remaining 1/8" x 4" brass tubing. Insert it through the rear wing alignment pin hole in the fuselage. Make sure the elevator push rod is **below** the tube. To easily fit and install the 1/8" x 1/4" x 2-11/16" spruce crosspiece. Hot Stuff it to the end of one of the 1/4" dowel pieces left from the push rods. This forms a "T" and gives you a handle to poke the crosspiece back into the fuselage. Taper the crosspiece ends to fit the fuselage contour. Mix some 5-minute epoxy and fasten not only the ends, but the entire length of both pieces. When the epoxy has cured, twist the 1/4" dowel loose and trim and file the ends of the tube flush with the wing root fillet.

13. Again using Hot Stuff (or whatever), stick the 1/4" wood dowel to the center of F3. Mark the position of this former on the outside of the fuselage using a pencil and the drawing measurements. (The importance of the location of F3 is so the floor will be flat.) Poke F3 back into position using the dowel as a handle. The fit needn't be perfect and F3 won't touch in the wing fairing area but touch up any high points with sandpaper. Cut a 2-3/8" length from the piece of 1/4" triangular balsa and epoxy it flush with the bottom of F3. Epoxy F3 in place, holding the position until the epoxy sets. Twist off the handle. The weight lifters in the crowd might feel more comfortable with a bead of epoxy and micro-balloons laid around F3. Check the fit of the 1/16" plywood ballast box floor. Sand to fit and set aside.

14. Clean the 11/32" main wing joiner tube with sandpaper and lacquer thinner or alcohol and insert into the fuselage. Trim the 3/16" x 3/8" x 2-3/4" spruce crosspiece to fit under the tube. Again, the handling of this piece is facilitated by adding the dowel handle with Hot Stuff. Mix up some 5-minute epoxy and fasten the crosspiece to the bottom of the tube and the fuselage sides. Now mix some 5-minute epoxy and micro-balloons and make a healthy fillet between the tube and the fuselage. Do not get any micro-balloons or epoxy on the underside of the crosspiece as the floor must fit into this area. File the tubing flush with the wing root fillet.

15. Try the ballast box floor in place again. It helps installation to make a plywood wedge with a handle that will wedge between the floor and the bottom of the fuselage. This will assure a tight fit. Coat the floor with epoxy at its contact with F3 and the crosspiece and put into place. Wedge against F3 and the crosspiece. Do not epoxy the sides to the fuselage.

16. Cut a piece of 1/4" triangular balsa to the same length as the bottom of F2. Epoxy these two pieces in place as shown on the drawing.

17. Care must be taken to avoid two potential problems in installing the two 1/8" x 5/8" x 13-7/8" plywood side rails. If the clamps used to hold the rails in place do not have their pressure

well distributed, they can dimple the fuselage sides; i.e., don't clamp directly on the fiberglass. Second, the rails are stiff enough to force the sides in, narrowing the cabin area. So, pay attention to shaping the front of the rails to fit the fuselage contour. This is the only shaping necessary. Make some cross supports to fit between the two rails to maintain the correct width until the epoxy sets. Use a strip of about 3/32" plywood or 1/8" balsa on the outside of the fuselage to distribute the clamp pressure. Use at least 15-minute epoxy to give you a chance to check everything before the epoxy sets up.

18. Cut the canopy frame side rails from the piece of 1/8" x 1/4" x 36" spruce. Cut the four crosspieces by measuring them with the side rails in place. Wedge the assembly in place but not so tightly as to spread the fuselage. You will find that shaping the forward end of the side rails to fit the contour will give a more comfortable fit. Epoxy the crosspieces in place one at a time. Allow epoxy to cure.

19. With the frame assembly up an eighth of an inch or so above the fuselage, coat the top of the frame with 5-minute epoxy and place the shaped canopy floor carefully in position, pressing lightly into the epoxy. Let the epoxy cure.

20. Seat the canopy floor onto the fuselage, slide small squares of wax paper under the floor, front and rear. Epoxy formers C1 and C2 in position, tight against the fuselage. Epoxy the 1/8" x 1/2" x 3/4" dowel reinforcement inside the fuselage. Drill the 1/8" hole through C1, fuselage and reinforcement and epoxy the 1/8" hold-down dowel into C1.

21. Trim the vac-formed A.B.S. housing to fit and paint it black. The canopy floor may be painted or covered with Trim Monokote or even Contact Shelf Paper.

22. If you prefer a colored canopy, dye it with household dye in hot (not boiling) water. Cut off both ends of the canopy blank, hold tightly to the frame (do not distort C1 and C2 with too much pressure) and mark 1/8" oversize with a felt-tip pen. Trim to this line.

23. We have had excellent results using Wilhold R/C 56 glue to bond the canopy to the frame. It is made for this purpose. However, use what pleases you. Coat C1 and C2 with R/C 56 and carefully seat the canopy on the frame. Use short pieces of masking tape to pull the canopy down on C1 and C2. Now, carefully get under the canopy sides and apply glue to the floor sides. Using lots of short pieces of masking tape, fasten the canopy tight against the floor. Any glue on the canopy may be wiped off with a wet rag. Don't be concerned with a small bead inside because R/C 56 dries clear. When dry (clear) trim flush with the frame. Add the simulated bow using 1/8" wide tape.

24. Enlarge the spoiler cable holes in the fuselage to 3/16".

25. Measure 2 ounces of lead shot or B-B ammunition into a paper cup. Mix enough epoxy to completely cover the shot. Mix well and pour into the fuselage nose. Stand the fuselage vertical until the epoxy is cured.

RADIO INSTALLATION

26. Not many specifics can be given regarding the radio installation. Each system requires a little different treatment. The drawing shows a typical installation that will work for most servos. A brick will require a different treatment. When the servos are located and screwed in place, install the stabilator and rudder (taped in neutral position). Using the drawing as a guide, bend the threaded 1/16" stabilator push rod wire to fit the installation. When trimmed to the proper length, file notches on the end that will be inserted into the push rod and screw a Mini Snap Link on the threaded end. Mix some 5-minute epoxy and force some into the push rod end. Apply a coat to the rod and insert into the dowel. Fasten the Snap Link into the elevator servo and let the epoxy set. Snake the rudder push rod through the fuselage and fish the aft push rod wire through the exit slot in the fuselage. Solder the threaded brass coupler onto the wire. Screw on a Snap Link. Position the rudder horn in line with the push rod and drill and screw into position with the coupling holes right on the hinge line. Bend the front push rod to fit your installation. Epoxy into the end of the push rod as you did for the elevator. Unscrew the Snap Link and remove the rudder push rod for painting. Take out the servos and your Aquila Grande' fuselage is ready for sanding and painting. Remove the rudder horn for covering.

SECTION V

COVERING AND FINISHING

We would recommend Super Monokote or other high quality covering material. Don't try to economize at this point. Follow the instructions included.

And now for the fuselage. Sand the seams smooth, also sand the entire fuselage to remove any contaminates. Fill any pin holes and cracks around the wing root rib with Hobbypoxy Stuff or Dap. For the final finish it's hard to beat Hobbypoxy or Super Poxy. Despite what anyone says, spraying is the only way to go. If you don't have a spray outfit, do what I do. I use a Preval sprayer, which is an "instant spray can". It consists of a mixing bottle and an aerosol power unit. The whole shebang only costs a couple of bucks and will do six or so fuselages. Then a new power unit puts it back in business. Spray on at least two coats of Super Poxy Primer or equivalent, thinned to spraying consistency. Wet-sand between coats. Spray the final color coats thinly following mixing instructions. Use a color chart to match Monokote colors. Wait about ten minutes between coats. The last coat should go on wet, but watch out for runs. If one develops, hold the fuselage horizontal with the run up. Keep working the run and rotating the fuselage until the worst of the run has disappeared. Then clamp a broom handle on your vise, ram it down the fuselage and leave it to cure, run side up. By the way, don't sweep your garage whilst the paint is drying. And do all your spraying out of doors. Epoxy paint fumes may be hazardous to your health.

SECTION VI

FINAL ASSEMBLY

1. If the radio switch is to be external, cut the hole in an area free of internal interference. If an internal antenna is desired, push a piece of outer Nyrod tube all the way to the back of the fuselage. Trim it just forward of F2 and epoxy to the fuselage bottom. Install the rudder push rod, screwing in the Snap Link. Install the towhook and adjust it to the position shown on the drawing.

2. Install the radio system. Be sure the receiver and battery pack are well padded.

3. Install the rudder and rudder horn. Connect the push rods. Make sure the rudder swings freely and returns to neutral. If not, look for binds.

4. Decide how you would like to hold down the canopy. A hook in the canopy floor and another in the bottom of the fuselage will do, connected by a rubber band. Or a music wire pin through the fuselage sides and the canopy frame is easy.

5. Install rubber skid to fuselage as shown on Sheet 1. Attach to nose with a No. 4 x 5/8" screw and a No. 4 flat washer.

SECTION VII

SPOILER FINAL INSTALLMENT AND RIGGING

1. Slit the covering in the spoiler bay, fold down and iron all around to the inside frame edges. Trim off surplus material and seal. Check the fit of the blade and cover both sides and all edges. Check that the blade is not warped. If it is, apply heat to the bowed side and hold straight until cool.

2. Cut a strip of Slictac (looks like Scotch tape with a paper backing) 1/2" wide by 14-1/2" long. Drop the blade onto the opening and center it so that the gap is even all around. Press on the hinge, cut to length and iron firmly to the wing and spoiler blade. Check the blade action.

3. Feed the cable through the tubing, starting at the wing root end, then through the screw-eye and back through the horn. Leave a half inch sticking out the end. Use a piece of round toothpick to wedge in place. Pull the cord to open the spoilers. Cut the stick-on weight in two and apply half to the bottom of each blade and check spoiler action. The blade must retract freely and be flush with the wing. Correct any binding before flying.

4. The final step is terminating the servo end of the cables. This is done after the spoiler servo is installed in the fuselage. First, screw two screw-eyes into the holes in fuselage bulkhead F2. Plug the wing panels in place, fishing the cord through the holes in the uselage sides and through the screw-eyes. Insert a No. 2 x 5/16" heet metal screw into the outer hole of a long servo arm, forming post. Wrap the cord 1/2 turn around the post, pulling the slack ut of the cord and attach the free end with tape. Check the spoiler action to be sure the spoiler opens to 90° and fully retracts. When satisfied, place a drop of epoxy or Hot Stuff on the cord, forming a small loop. Cut off the excess cord. Repeat the process for the other panel. Any further adjustments can be made with the toothpick wedge in the spoiler horn.

SECTION VIII

PRE-FLIGHT CHECKS

1. Assemble your Aquila Grande'. Support the sailplane with your fingertips under the wing root to check balance. The model should balance when supported at the rear edge of the main wing joiner. Add weights under the battery pack until balance is achieved. Secure the weights so they cannot move.

2. Check the radio and control system. When you pull the stick back does the leading edge of the stabilator go down? When you move the stick left does the trailing edge of the rudder go left? This may all sound stupid but I've seen several ships demolished on the first flight by experienced pilots flying with crossed controls.

3. It never hurts to try several test glides over a grass field. This gives you a chance to set trims and look for any ususual turning or pitch problems.

4. Finally, when all looks OK, give it a go.

If you use a high-start, make sure it has plenty of zip, you are flying a ten foot sailplane now. It should go straight up with no problems.

SECTION IX

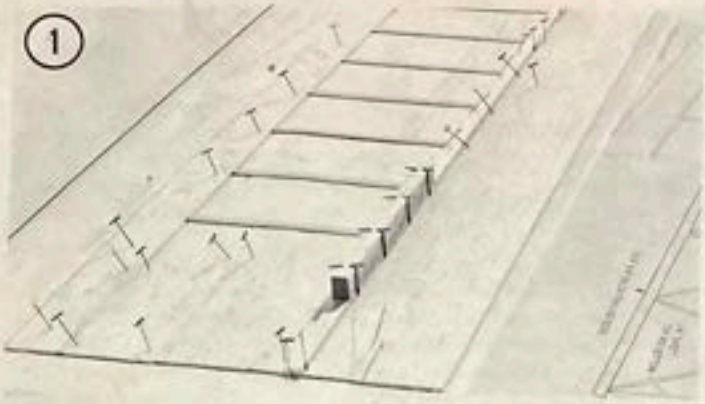
FLYING THE AQUILA GRANDE'

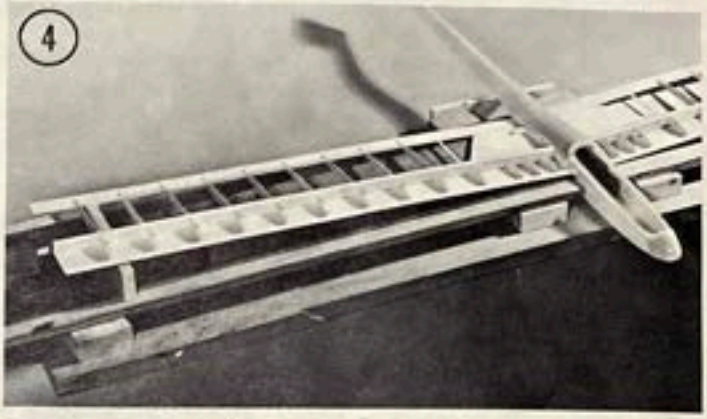
I won't presume to instruct you in flying sailplanes. Most people building the Grande' will have had considerable experience in this department. If you have flown the standard Aquila, you will be right at home with the Grande'. Don Edberg has had lots of contest experience with both the standard Aquila and the Grande'. I asked him to compare their flying characteristics. "The Aquila Grande' is more efficient, with a better L/D and surprising light-air performance," he said. "But," he cautioned, "the Aquila Grande' must be flown faster. It just will not perform if you try to drag it around like an Olympic II. If you find yourself flying around nose-high, try putting in some down trim. Landings should be made fast, opening the spoilers for final descent into the spot. However, it does have very good steering characteristics even when slowed down on landing." There you have it from an expert.

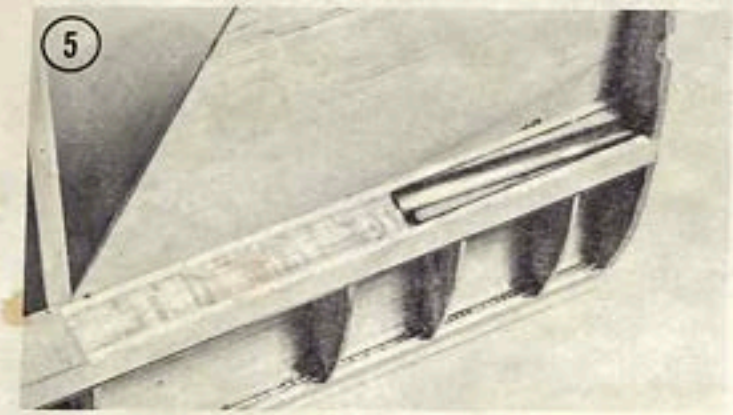
The Grande' was designed to perform well in FAI competition. Put the nose down and it will really move out. After a max flight, Edberg usually dives the Grande' to lose altitude quickly, coming over the field like the Bombay Express. We have never seen any tendency toward flutter of any kind. However, any wing will flutter if flown fast enough so I wouldn't try a vertical dive from a thousand feet.

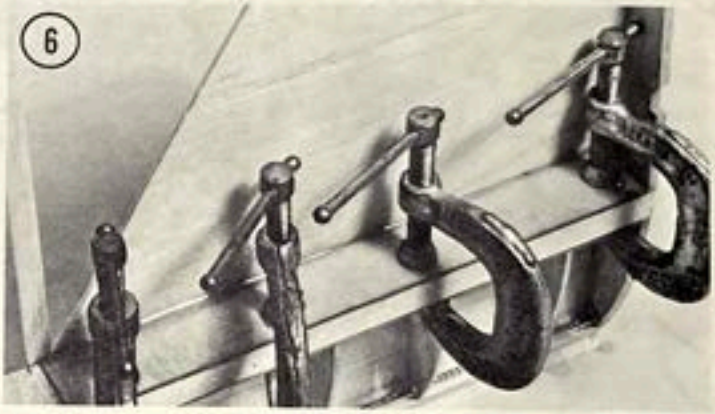
The wing root is exceptionally strong with two full-depth plywood shear webs and 3/8" wide spar caps. Although the wing is "strong like a bull" take it easy when launching in windy weather. There is not so much worry of wing failure as there is for line breakage. The Aquila Grande' has lots of wing area and will put plenty of tension on the line. A line break just after launch is awfully hard on airplanes.

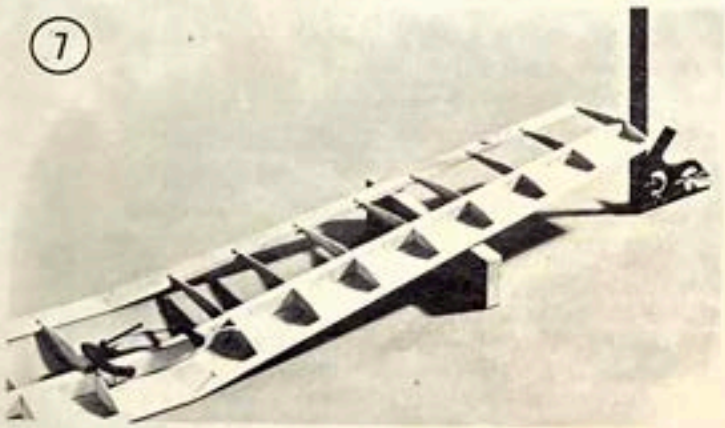
Well there you have it. We hope you like the Aquila Grande'. Fly it in good health.

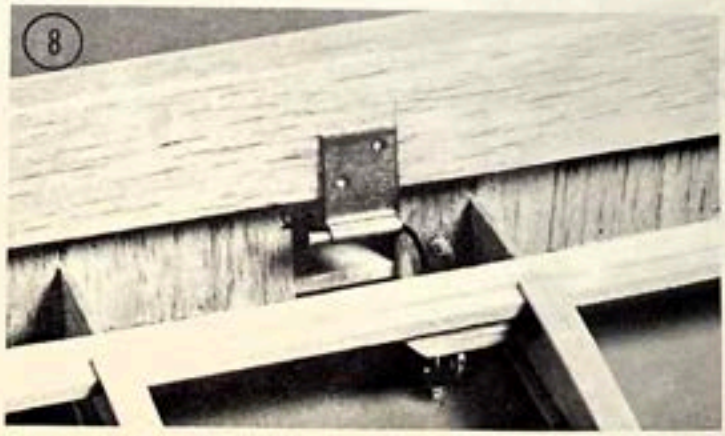




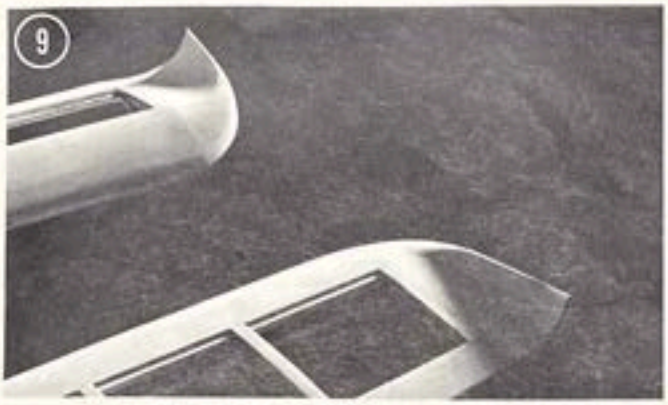


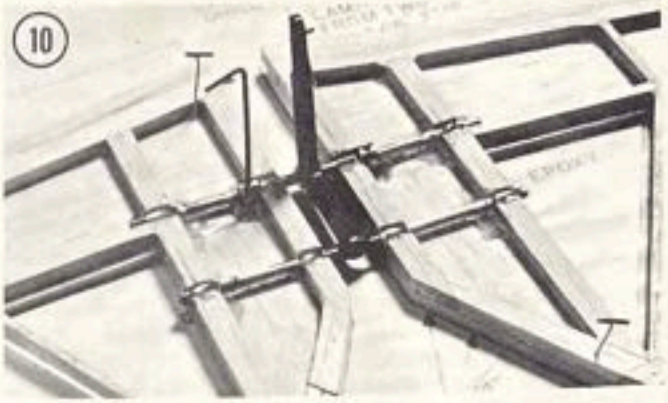


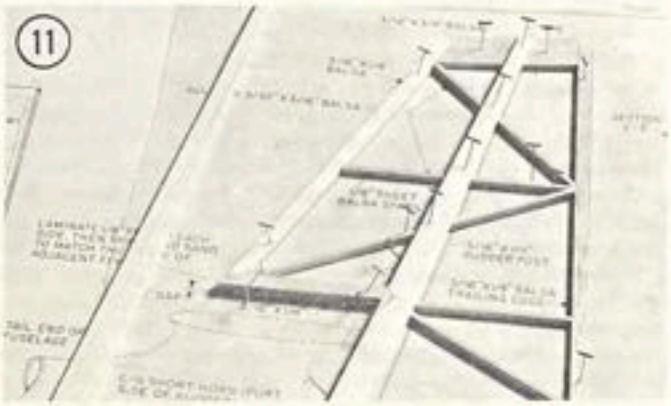


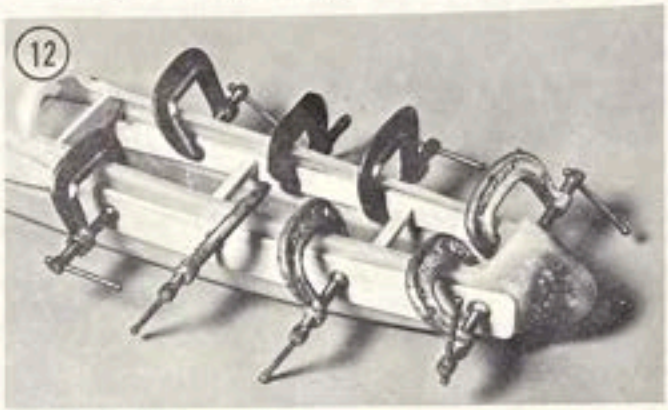


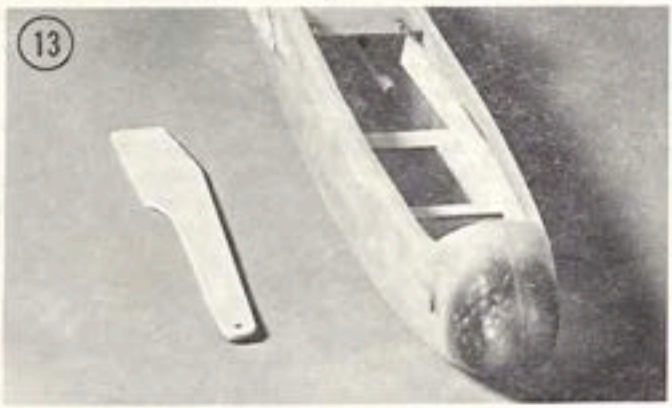
(1) First phase of wing construction — Section I, Steps 1-10. (2) Fastening forward ribs to lower leading edge sheeting — Section I, Step 18. (3) Fastening ribs W2 and W3 to lower leading edge sheeting and to shear web W14 — Section I, Step 19. (4) Jig used for aligning joiner tubes — Section I, Step 27. (5) View showing wing joiner tube and wedges epoxied in place — Section I, Step 29. (6) Clamps hold plywood shear web W15 in place while epoxy sets — Section I, Step 29. (7) Dihedral is set with block. Inner and outer wing panels are joined — Section I, Step 43. (8) Spoiler blade in extended position. Toothpick retainer holds dial cord to spoiler horn — Section I, Step 53; Section VII, Step 3.

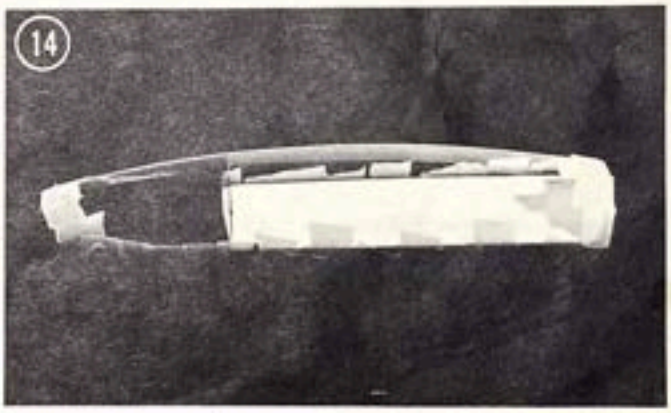


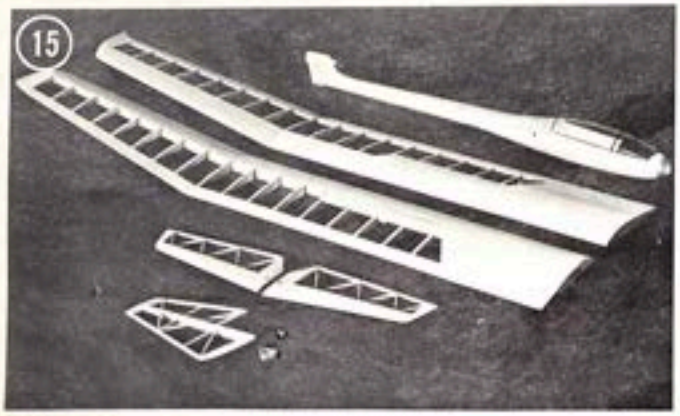


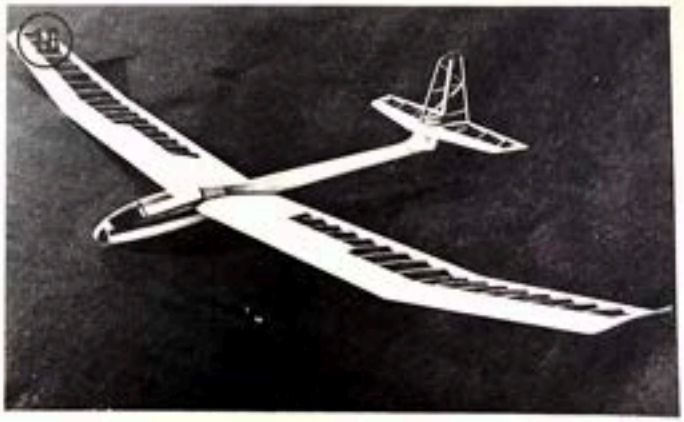












(9) Wing tips rough carved and sanded – Section I, Step 54. (10) Stabilator assembly – Section II, Step 9. (11) Rudder assembly – Section III, Step 4. (12) Side rails epoxied in place – Section IV, Step 17. (13) Completed fuselage ready for finishing. Ballast box installation wedge shown – Section IV, Step 15. (14) Canopy is held to frame with masking tape while glue dries – Section IV, Step 23. (15) All parts sanded and ready for covering and painting. (16) The assembled Aquila Grande'.