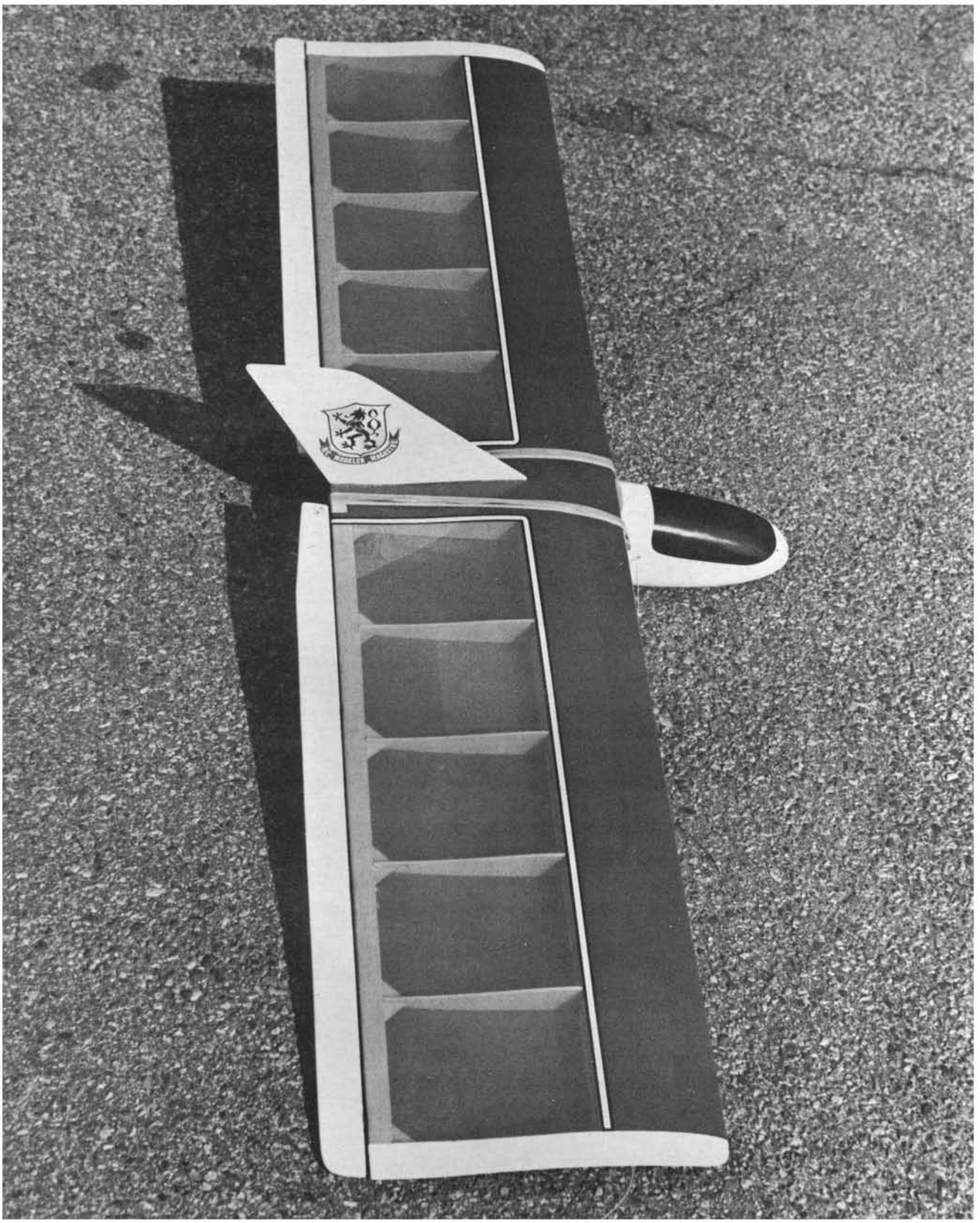
little plank

CHUCK CLEMANS
and
DAVE JONES



Editors Preface: After receiving the construction article for the Little Plank from the authors, Chuck Clemans and Dave Jones, I was totally intrigued by the design of the aircraft and by its performance potential. The RCM prototype which I constructed from the authors original plans, weighed 25 ounces and had a wing loading of approximately 5 ounces per square foot. The amount of "rake-up" of the elevons proved to less than shown on the plans and no engine of any type was used, our Little Plank prototype being set up for Hi-Start and electric winch usage. The first few flights required some 'sorting out' of the aircraft to obtain the proper trim for thermal flying. The model proved to be one of the most remarkable thermal soaring machines we have flown to date and competed favorably with many high performance thermal machines in the area. In fact, the full thermal potential of this ship was never fully realized even with over 100 flights to its credit. It goes up on an electric winch, or Hi-Start, like it was on rails and, while its flight speed is quite fast compared to the conventional sailplane, it virtually acts as a "thermal sensor" in the air. Without any dihedral whatsoever, and its extremely low wing loading, the model reacts to even the smallest thermal by raising a wing tip sharply. Turns can be made so tight that it is almost like a pylon racer and staying in a thermal is virtually a unique experience. While the Little Plank can be thermaled in a circular flight path similar to any conventional sailplane, by applying full up trim on our particular prototype, the model would shoot straight up the center of the thermal.

Once properly trimmed, and once the flyer has become used to this unusual machine, we found that it equalled the best thermal times of the high performance ships that we pitted against it. The Little Plank is definitely not a beginners machine by any stretch of the imagination. With sensitive elevons, no dihedral, and a fast forward flying speed coupled with excellent penetration, the Little Plank requires your constant attention to fly it. You cannot take your eyes off this ship and expect it to be in the same attitude as you left it! This ship is more analogous to flying a full house competition multi insofar as it has to be flown all of the time and you can easily become disoriented due to its configuration. We were extremely impressed with the performance characteristics of this model and its ability to perform with the best of them in thermal competition. If you are a soaring pilot who has passed the novice stage, we recommend this design to you for a complete change of pace in soaring as well as a challenge to your thermal piloting skill. It is an excellent design based upon several years of research by the authors and has a performance potential that has yet to be reached to its fullest extent. . . . Don Dewey

RCM PHOTOS BY DON DEWEY

The Little Plank is one of the most exciting and challenging sailplanes we have yet flown.

Designed for the experienced flier, it is equally at home in thermals or on the slope.

Optional pusher engine shown.

The Little Plank is a design for slope soaring, thermal soaring, and sport flying. It makes use of the plank configuration to provide ease of construction and maximum performance with low power. The principle design features are:

Configuration: Flying wing with zero sweep back and constant chord.

Fuselage: No internal bulkheads.

Rudder: Centrally located, non-moving, permanently attached to wing.

Power: .049 to .10 in pusher configuration, prototype used TD .051 with Cox tank mount and TD .09 with Tatone mount and internal tank.

Controls: 2 channel with elevons for pitch and roll functions.

Control Linkage: Uses sliding servo for roll and fixed servo for pitch. Both servos are mounted on a plywood rack to allow removal as a unit. Breakaway linkage to prevent servo damage due to crash.

Wing Section: S-1 with no undercamber. A 9½% section with mild reflex. A reflexed Eppler 385 section has been developed and will be tested in the near future.

Dihedral: None, tip shape provides small dihedral effect.

Construction: All balsa using standard wood sizes. Plywood used at stress points.

Weight: Less than 2 lbs., using PCS radio and KPS-10 servos and TD .051-2.5 lbs. with TD .09. 25 ounces as thermal soarer without power.

Performance: Surprisingly fast with TD .051. Capable of 10' diameter loops, rolls, and inverted flight. Six foot diameter turns possible on the slope. Will fly hands off when adjusted for circular flight. Tows well on electric winch or Hi-Start.

The Little Plank is a sport design for the Sunday flyer or others desiring a change of pace. While the plank configuration sacrifices efficiency due to the reflexed airfoil, it offers advantages in compactness, ease of construction, maneuverability and versatility. What other design can be thrown off a slope, winched, fly under power, and will loop, roll, fly inverted, alarm spectators and frighten birds?

Historical

The plank, or ironing board configuration, is not new. Our first one was a Dutch design called the "Ironing Board". This was in the late 1940's. Later, the British magazine, Aeromodeler, published three views for a towline glider and the coordinates for a so-called self-stabilizing airfoil. This airfoil, a 9.5% reflexed, undercambered section was the basis for a design series which included a 300 sq. in. towline glider and a 1200 sq. in. radio controlled slope glider in addition to the Little Plank. The Little Plank utilizes a flat bottom version of this wing section for improved penetration and simplified covering.

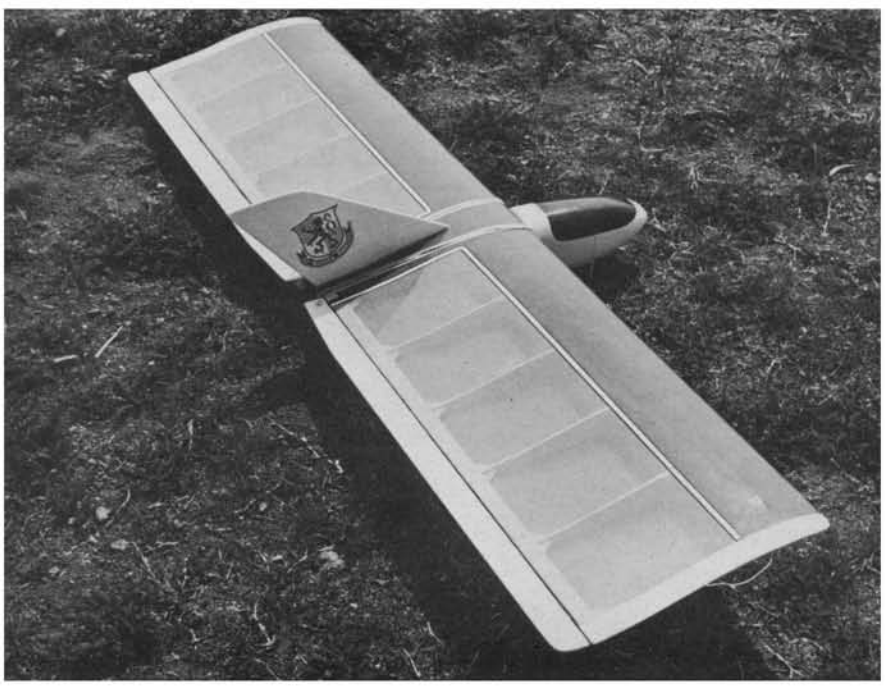
Design

The current design is the joint effort of Chuck Clemans and Dave Jones. Dave is the proprietor of Western Plan Service, 5621 Michelle Drive, Torrance, California 90503. A request to the above address will produce a list which includes a variety of designs for slope and thermal, with such unusual items as a semi-scale Spitfire for slope and a 2500 sq. in. plank for FAI record attempts. Dave is responsible for the basic aerodynamics and configuration while Chuck, who resides in the Seattle area, can be given credit for power modifications, construction and flight test.

RCM's prototype of the Little Plank weighed 24 ounces, had over 200 flights at time this photo was taken.

The Little Plank is an attempt to produce an aircraft which one can carry assembled to the field and is at home either at the slope or in a thermal. It is maneuverable and requires a minimum of power. The pusher configuration was used because of efficiency advantages and to reduce the post-flight cleanup problem. The size of the Little Plank allows the use of a TD .051 for sport flying or an .09 for the more adventurous. Power could be increased still further but is not recommended. The Little Plank is stong enough to accept a .19 but two problems must be resolved. The flat bottom airfoil with reflex will cause large trim variations between high and low throttle due to center of pressure movement. Further, the center of gravity must be between 17% and 20% for reasonable stability, which may be difficult to achieve with the weight of a larger engine in the tail.

Finish is white Aerogloss dope over silked fuselage with wing covered with red and transparent yellow Solarfilm. Tips, elevon and vertical fin are white Solarfilm.



The design of the wing tips provides a small amount of effective dihedral which, while improving stability for circling in thermals, does not cause problems in maneuvers such as roll, Immelman, etc. Elevons for control in pitch and roll simplify the installation since separate pushrods and bellcranks are not required for the ailerons. Aileron differential is not used on the original and does not appear to be needed.

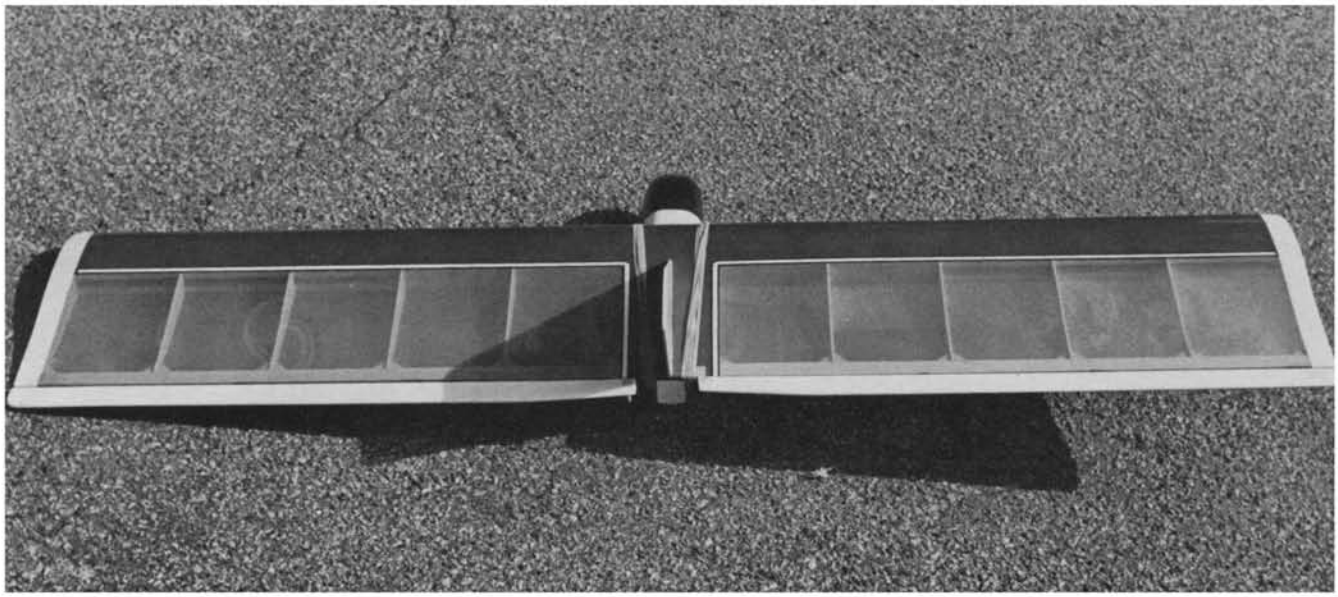
Flight Tests

Due to the unusual configuration and the variety of flight modes intended for this design, an extensive series of flight tests was undertaken. These tests were conducted over a period of several months in widely diverse weather conditions and resulted in several improvements to the original design. Slope tests were conducted with engine and propeller in place in conditions ranging from mild shear to straight-in at 35 mph. While the Little Plank can not be considered an exceptional dead-air machine, it is outstanding in high winds. Extended inverted flight (the reflexed airfoil requires about 1/4 down stick), rolls, and loops were accomplished with ease.

Powered sport and thermal flying presented nothing unusual but did suggest some changes. The engine run with the TD 051 using the Cox tank mount was considered a bit short for sport flying. A 1 oz. internal tank was mounted for use with the TD 051 and later tests with the TD 09. One thing to remember is that pushers tend to richen up in the nose-up attitude due to tank position which is the opposite of tractor configurations. This means that the engine should be adjusted with the aircraft in a slightly nose-up attitude prior to launch.

A TD 09 was installed to evaluate sport flying characteristics with additional power and to provide a faster climb rate to thermal country. The TD 09, while improving the sport flying characteristics, sacrifices soaring ability due to the extra 1/2 lb. which must be carried in the form of engine, tank, and ballast.

During the tests with the TD 09, it was noted that the Little Plank would sometimes protest audibly when the speed got above a certain point. A series of dive tests was undertaken to investigate this problem and you



Rear view of Little Plank shows straight wing, rear mount for pusher engine, if desired.

guessed it – FLUTTER! Several modifications were made in an attempt to eliminate this problem including straightening the pushrods, pinning the hinges and sealing the hinge line, all of which delayed the onset of the flutter but did not eliminate it.

A solution to the flutter problem was finally achieved by reducing the width of the elevons from 2" to 1-3/8" as shown on the plans. The Little Plank can now sustain vertical dives in glide or powered flight without protesting. This might be useful if you ever find one of those "Killer Thermals" we keep reading about.

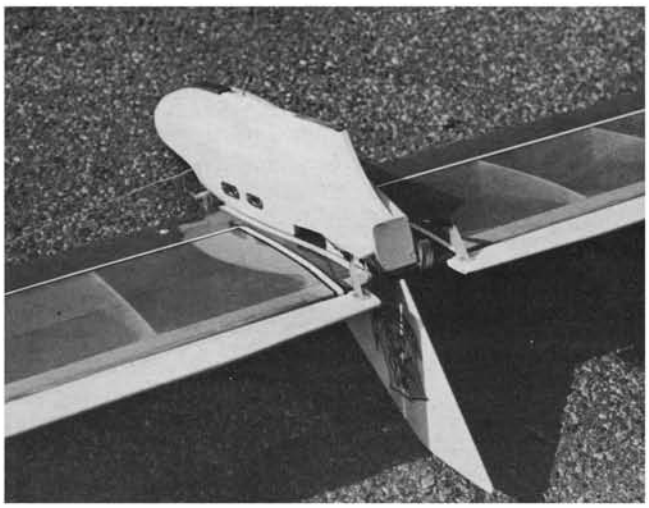
Tow tests were conducted using an electric winch and roughly 1,000 feet of 30 lb. line. No problems were encountered even with crosswind launches. Begin with full-up and concentrate on keeping the wings level. With the ply shear webs you don't have to worry about wing failure.

The durability of the Little Plank was tested by flying it into a sign, a freeway, and a small alder forest (all on purpose of course!) The only damage was to the fuselage which was ¼" shorter after the sign and freeway tests. Be sure and use a nylon clevis such as Williams Bros. between the elevator and aileron servos as the pin will pop out of the clevis **before** the servo gears strip.

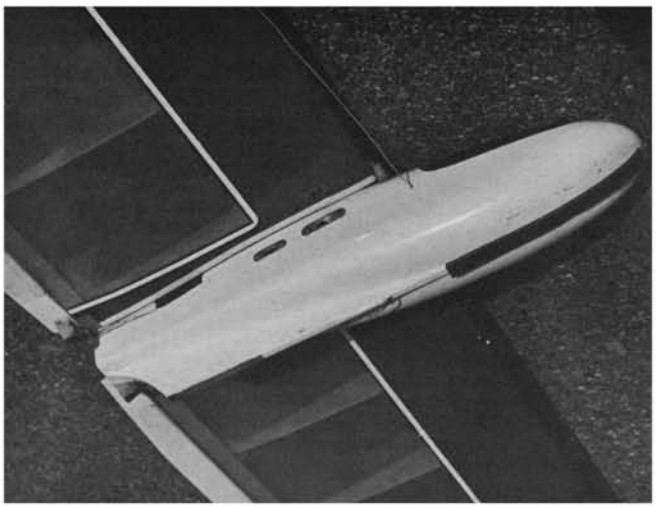
The color scheme of the original Little Plank was chosen for visibility at high altitude and to reduce orientation problems. The fuselage and bottom of the wing are black. The upper surface of the wing is orange trimmed with black. The rudder is orange with a reflective chrome sunburst. RCM's prototype used a white acrylic fuselage with blue canopy (painted) and a wing covered with transparent yellow and opaque red Solarfilm.

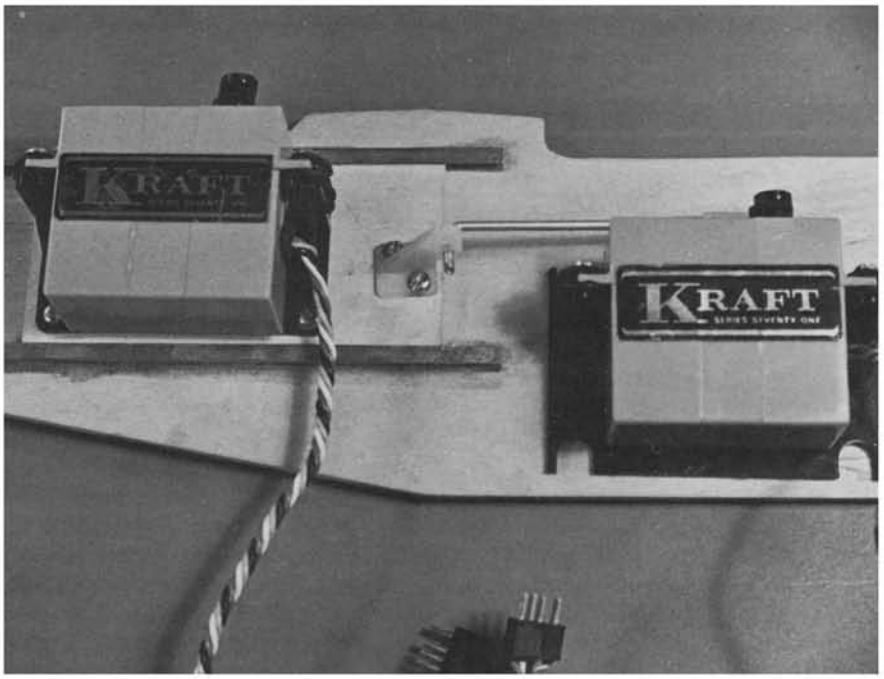
Other Little Plank's which have been built from my rough plans have shown flight characteristics similar to the original. An exception was one which was test flown with ±3/4" elevon throw instead of the recommended ±3/16" and a rearward CG location. It was reported to have done three snap outside loops off the tow and nearly given the owner a heart attack. Stick with the control movement and center of gravity shown on the plans for the initial trim flights.

Note straight pushrod connection to elevons. Underside of elevons sealed with full length strip of clear MonoKote.



Fuselage pod with tow hook and skid. Latter made from two strips of servo mounting tape and a strip of polypropylene "Living Hinge."





View of servo mounting in Little Plank. Aileron servo tray slides in brass rails. Kraft KPS-12 servos.

CONSTRUCTION

Use light balsa throughout. The objective is to arrive at a ready-to-fly weight of 1¾ – 2 lbs. for thermal flying. For slope flying, weight is not critical, unless you want to hang in there during minimum lift conditions. For sport and average slope flying, 2 – 2.5 lbs. is acceptable with the .09 engine.

Wing:

Using a template for accuracy, cut the ribs from soft 3/32" balsa. The trailing edge is an odd size, 5/16" x 3/4" x 3/16". Standard 1½" trailing edge stock can be utilized if split down the middle. Another way to produce the trailing edge is to laminate two ¾" wide strips of 1/16" (on top) and ¼" balsa. In either event, use light balsa.

Splice the wing spars and leading and trailing edge stock. At this point, you have most of a wing kit. Cut about ten trailing edge jig blocks from scrap balsa and use them to hold the trailing edge in position above the plan. Pin the lower main spar in place, shimmed with 1/16", to allow for the lower forward planking. Cement all ribs in place using Titebond. Make certain all ribs are vertical and wipe off any excess glue around the main spar to avoid problems when installing the shear webs. Glue the upper main spar and leading edge in place and let everything set up.

Cut some 1/32" ply strips and web the main spars as indicated (remember to shim 1/16" on bottom). Using a sanding block, shape the upper leading edge to accept the top sheeting. Prepare the top sheeting by coating the upper surface with water or household ammonia and glue in place with model cement. Plank the center section and set aside overnight. (I hope you remembered to remove an extra 1/16" aft of the upper spar on the center section ribs – I usually forget to).

When dry, remove the wing from the board and shape the lower leading edge. Replace the wing on the board inverted, jig the trailing edge, and add the remaining 1/16" sheeting. Remove from the board when dry and add the dead soft balsa tips. Prior to final sanding of the wing, give all rib trailing edge joints a second thin coating of glue.

Sand the wing tips to match the upper airfoil then cut the leading edge of the tip to the shape indicated on the plan. Bevel the underside of the tips from the lower airfoil surface to within about 1/16" of the upper surface. Cut the elevons from 3/16" soft balsa and add plywood inserts for the control horn mounts using Titebond glue.

Cover the wing and elevons with MonoKote or Solarfilm leaving a gap where the rudder will attach and add the hinges. Seal the gap between the elevon and wing with a MonoKote strip on the underside. Be sure and allow enough slack so that the motion of the elevon is not inhibited. This excess can be creased into the gap after application. If old style (wet) MonoKote is used, spray a bit of silicone lube into the top of the hinge line to neutralize the excess MonoKote adhesive. after covering the rudder, attach it to the wing with epoxy. This joint is quite strong due to the curvature of the wing surface.

Fuselage:

The width and shape of the pod can be adjusted to suit your equipment but retain the nose moment and side area shown. Use soft wood throughout and build a box consisting of sides, top

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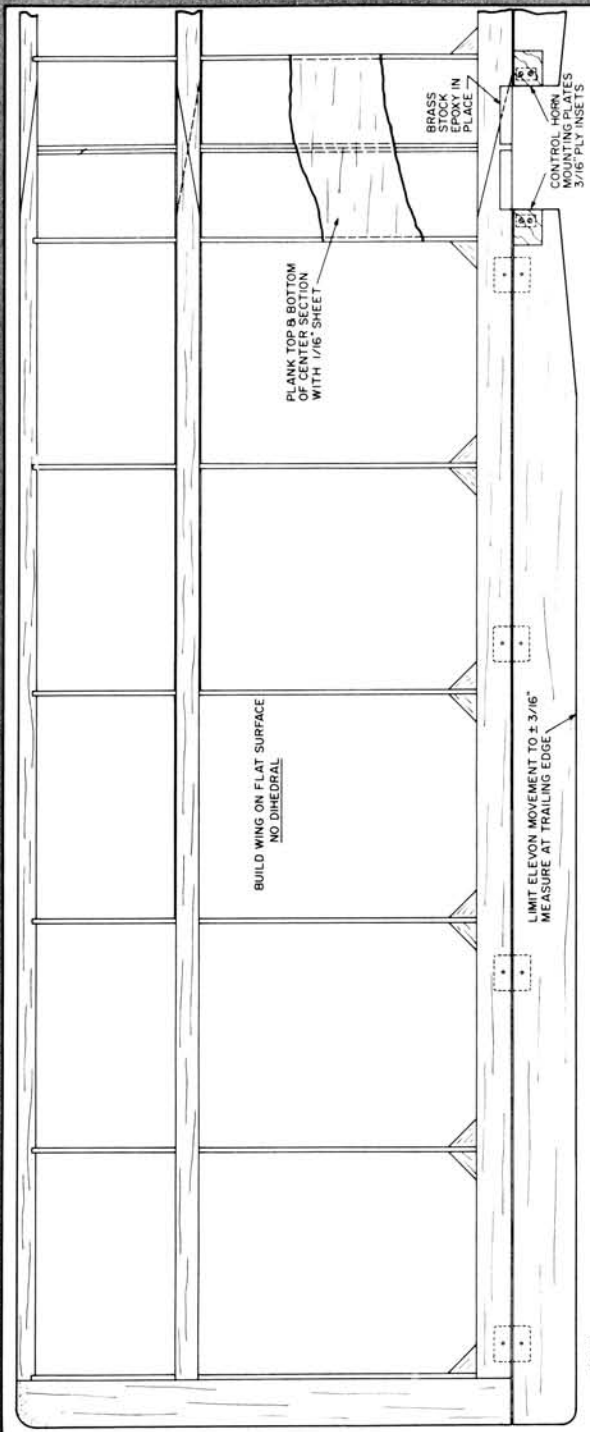
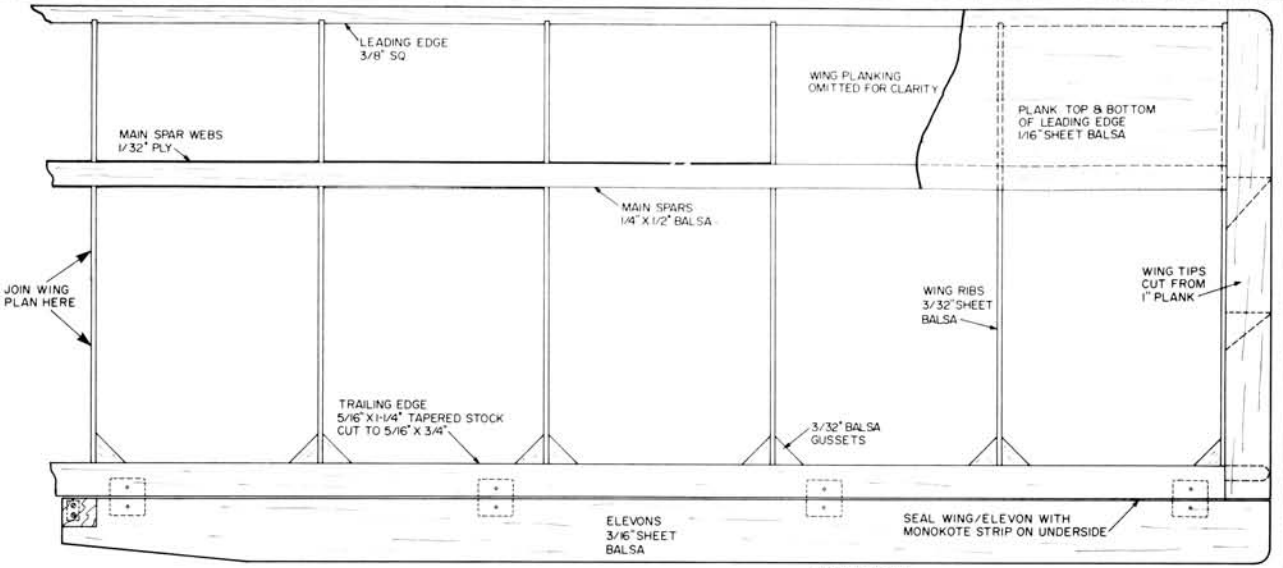
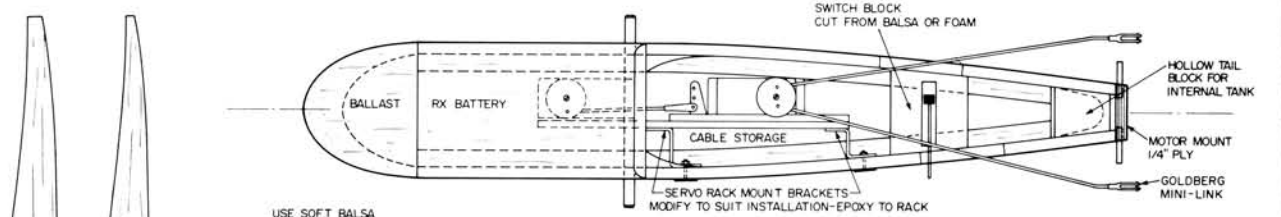
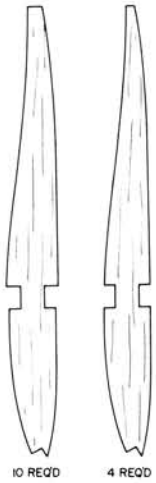
Author's Little Plank in flight. Photo taken at 100 acre Boeing Hawks field at the Boeing Space Center in Kent, Washington.

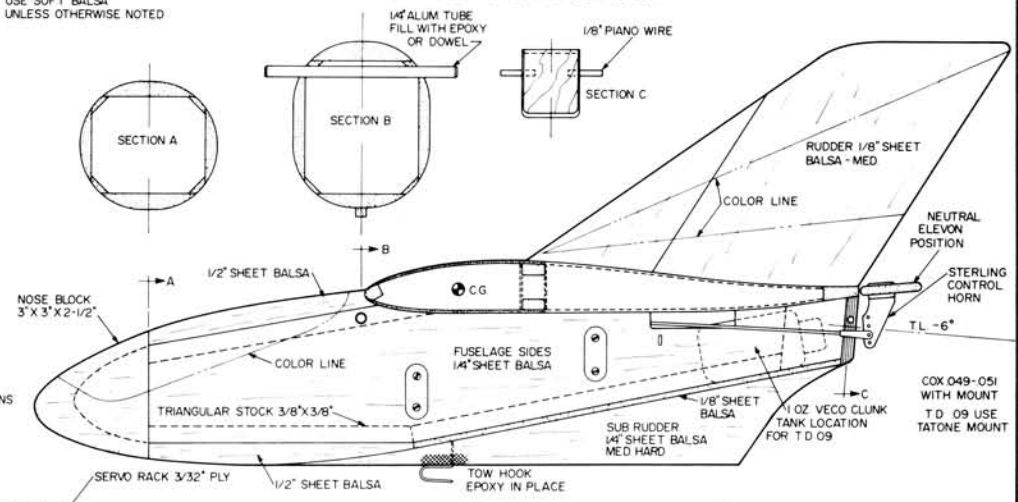


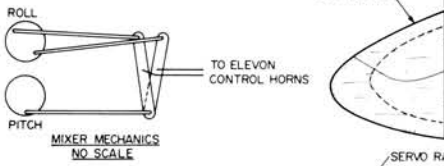


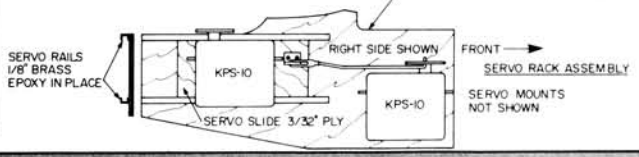


USE SOFT BALSA UNLESS OTHERWISE NOTED









WING SPAN 56 IN.
WING AREA 673 SQ IN
WEIGHT 2 LBS
WEIGHT RANGE 175-25 LBS
POWER 049-10
DESIGN TYPE - SPORT, SLOPE, THERMAL.

Little Plank

DESIGNED BY	CHUCK CLEMANS DAVE JONES	DRAWN BY INKED BY	CHUCK CLEMANS D & R KIDD

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block, and bottom block. When dry, add 3/8" triangular stock and carefully sand the front end to accept the nose block. Spot glue the nose block in place using 5-Minute Epoxy and add the tail block using a clamp to hold the rear sides in place. Add the 1/8" bottom sheeting and remaining 3/8" triangular stock. Cut out the ¼" ply motor mount plate and recess and epoxy the blind nuts for the tank mount (or Tatone mount). Fill the nuts with wax or soap and epoxy the motor mount plate to the rear of the fuselage. Note that the engine thrust line is −6 degrees relative to the flat bottom of the wing. No side thrust is required.

Sand the fuselage to shape and install the medium hard balsa sub-rudder. Remove the nose block and hollow for ballast. Prior to cementing the nose block permanently in place, construct the servo rack and trial fit all equipment.

Control System:

A sliding servo and mounting rack was used on the prototype and provides an easily removable system. A further advantage is that a hatch is not required. A mixer is depicted on the plans and would provide an automatic reduction in surface throw. Whichever system is used, try for minimum slop in the system to avoid flutter.

The keel for the sliding servo system is cut from 3/32" birch or 1/8" mahogany plywood. The servo slide is 3/32" birch ply. Both servos are mounted using plastic side mounts with bolt heads recessed. Use the servo slide to align the slide rails and epoxy the latter in place. Ensure a close but free fit between the rails and slide.

The servo mount brackets are epoxied to the servo keel and adjusted to place the servos as near the center of the fuselage as possible. Drill 1/8" holes in the bracket so epoxy rivets will form to ensure a good joint. On the prototype, an aluminum plate was used to secure the bracket bolts. A more neat installation can be provided by inserting a ¼" dowel or a plywood plate where the bracket bolts exit the fuselage.

Final Assembly:

Glue the nose block in place and sand the fuselage to final shape. Cover the fuselage with Solarfilm, MonoKote or otherwise finish. Add the wing hold-down tube (fill with epoxy or dowel) and rear hold-down pins. Nylon bolts can be used to secure the wing but you are on your own. Remember to provide a stop for the servo keel if the forward hold-down tube or dowel is not used. This will prevent damage to the RX or battery pack during a crash as a result of the servo rack moving forward. The antenna exits the fuselage about ½" below and behind the wing leading edge and is secured with a rubber band and pin at the rear of the wing tip.

Flying:

Balance at the point shown on the plans which corresponds to 17% of the theoretical wing section at approximately 2" behind the leading edge. A good way to do this is to mount two pencils upright in a vise (or in holes in a board). The aircraft can be precisely balanced by suspending it between the two pencils. The erasers on the pencils will keep the plane from slipping. For pitch stability the allowable CG range is 17% – 20%. With the CG at 17% the neutral elevon position is as shown on the plan. Control movement on the prototype was ±3/16" measured from the bottom of the elevon trailing edge.

Make initial slope flights in medium or average lift conditions. Save the light air until you are familiar with the Little Plank. Set the elevons at full up-trim and launch briskly into the wind. Apply down elevon as required for penetration. With practice, 6' diameter turns can be made on the slope (into the wind of course).

The Little Plank handles well on an electric winch or Hi-Start, going up like it's on rails. Begin with full-up and ease off to adjust the rate of climb.

Initial powered flight is a snap! Apply full-up trim and launch briskly into the wind. Be prepared to apply down to control the climb angle. The best climb rate is achived by launching into a thermal, of course. Otherwise, use gentle figure eights into the wind.

With the TD 051, Cox tank mount, 6 x 3 pusher prop, and Super Sonic 100 fuel, you can expect from 600' to 800' altitude in dead air. With the TD 09 and a 1 oz. tank you can go out of sight. A 7 x 4 pusher prop should be about right for the .09 if you can find one. Flight tests with the TD 09 were conducted using an 8 x 6 cut down to 7 x 6 which works but does not allow the .09 to achieve full power.

For sport flight, 10' diameter loops are accomplished with ease. Rolls are best entered from a shallow dive to gain speed. A little down trim and you will be surprised at how fast an .051 can move 600+ square inches!

In conclusion, a word of caution is in order. The general configuration of the Little Plank means just one thing to birds – HAWK! This was demonstrated recently at Boeing's Kent, Washington flying site when about 100 small birds scrambled and tried to force the plane out of their air space. If you have hawks in your area, be prepared to share your thermal since they are a curious lot and may mistake you for a brother.

For those of you who build a Little Plank, drop us a card with questions, suggestions or comments c/o R/C Modeler Magazine.

BILL OF MATERIALS

BALSA: 1 – ¼" x 4" x 36" fuselage sides and sub rudder; 1 – 1/8" x 3" x 36" fuselage bottom and rudder; 1 – 3/16" x 3" x 36" elevons; 2 – 3/32" x 4" x 36" wing ribs; 4 – 1/16" x 4" x 36" wing sheeting; 4 – ½" x ¼" x 36" wing spars; 2 – 5/16" x 1¼" x 36" trailing edge stock; 2 – 3/8" x 3/8" x 36" wing leading edge; 1 – 1" x 2" x 12" wing tips; 1 – ½" x 3" x 12" fuselage top and bottom; 1 – 3" x 3" x 2½" nose block; 2 – 3/8" x 3/8" x 36" triangular stock.

PLYWOOD: 1 – 6" x 12" x 1/32" shear webs; 1 – 6" x 12" x 3/32" servo rack assembly.

MISCELLANEOUS: 1/8" x 1/8" x 12" brass servo rails; 1/8" dia. wire, rear wing hold down; ¼" dia. Al. tube or dowel, front wing hold down; ¼" ply, motor mount; 3/16" ply, control horn mounting plates; 0.04 Al., servo rack mounting brackets.