CARDBOARD 500

DESIGN BY BOB MILLER

ARTICLE BY CHUCK FELTON

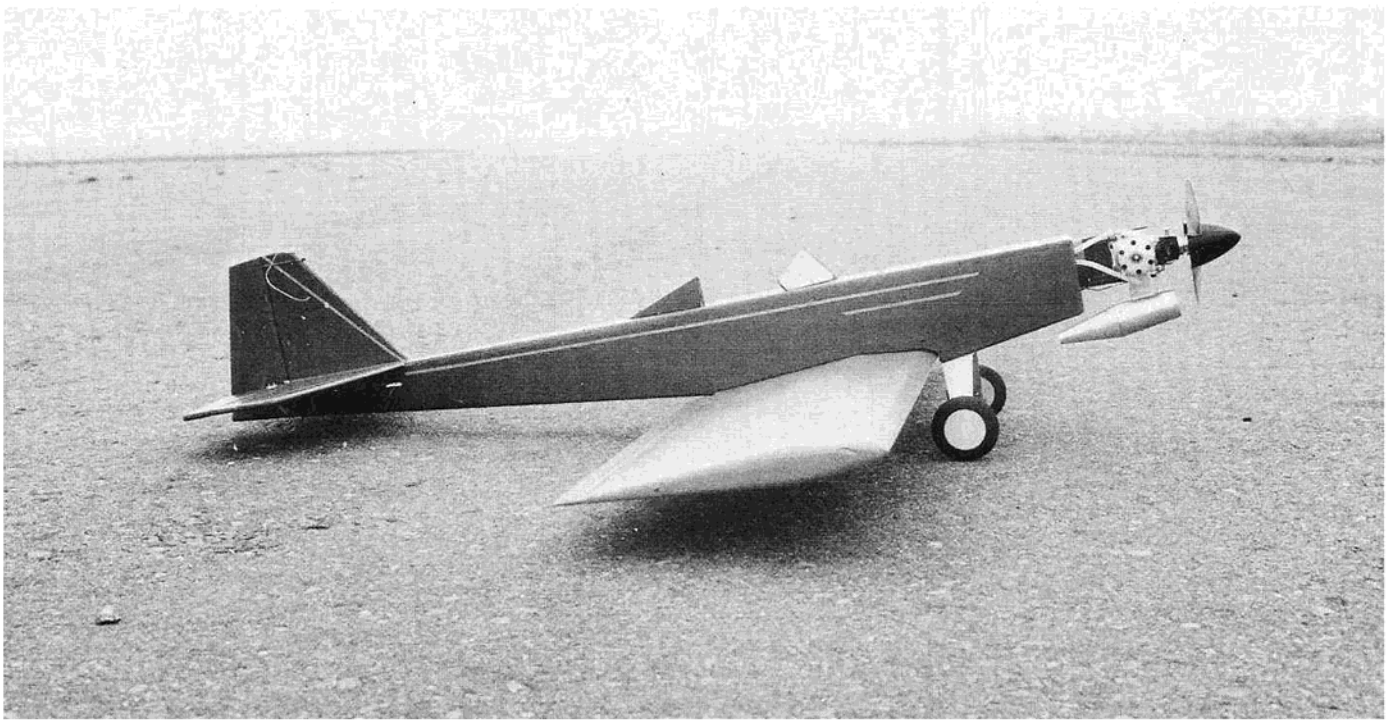
The search for new and different materials for model airplane construction has led from balsa to foam to plastic and fiberglass. However, each new material has generally proved more expensive than the last and required specialized techniques and skills not always available to the average modeler. Modeling becomes more expensive and complex and discourages beginners from joining our ranks. What is needed is an inexpensive, readily available, easy to work material which can be used in a wide variety of applications. Cardboard meets all of these requirements. The use of cardboard for model airplane construction is not new. But, generally, these designs are looked upon as novelties. No effort has been made to develop the use of cardboard to its fullest potential.

The advantages of cardboard as a construction material are numerous. The most important factors are the low cost and availability. Most clubs have some member who is connected with the container or packing industry, or other related businesses such as grocery or department stores, who can serve as a source of supply for cardboard. All that's needed to cut out cardboard pieces is a sharp razor blade. Sharp corners or rounded edges are equally easy to cut, with no worry of cracking or splitting as with balsa wood sheets. In addition, since it comes in large sheets, large sections may be made from one continuous piece. The ease of cutting,

combined with the large shapes which may be formed from a single piece of cardboard, have resulted in simplified design techniques and reduce building time to an absolute minimum. The weight of cardboard varies considerably, but the lighter weight cardboard can be used to build models which are less than, or equal in weight to, models using standard balsa wood construction, while still maintaining adequate strength and durability.

Bob Miller, the designer of the Cardboard 500, has been building and flying cardboard radio control models for over 5 years. His interest was prompted by the introduction of the Paper Tiger kit, a cardboard model, which appeared over 5 years ago. This kit showed that cardboard could be used and be comparable in weight to standard construction materials. Bob Miller has designed both high and low wing airplanes and single and twin engine configurations up to 75'' in wing span. He has supplied over 50 of his cardboard airplanes to fellow R/C club members who have flown them with satisfactory results. The largest was a 9½ pound model powered by a .60 engine with a 1300 square inch wing area which flew realistically. Experiments with various airfoil shapes were conducted, and the one chosen for the Cardboard 500 was picked for ease of construction, weight, strength, and overall flying qualities.

The building techniques used in the Cardboard 500 were developed by Mr. Miller. Three basic methods of construction were investigated: lap joint, slit scoring, and folding. The lap joint method uses separate pieces glued together and results in an unfinished edge at each joint which must then be sealed over and sanded. In slit scoring, the component is cut from a single piece of cardboard with slits cut through the outer facing and flute material, but not the inner facing. The cardboard is then bent along the slit lines. This leaves a notch at all corners which must be filled in with balsa or glue. The folded method provides the



simplest and fastest method of construction. The component is made from a single piece of cardboard which is then scored on the inner face side and folded on the score lines. This usually results in only one unfinished edge which is then sealed over. The folded method also provides greater strength and reduces the number of stiffeners, such as fuselage bulkheads and wing ribs, required to insure adequate rigidity.

The Cardboard 500 can truly be called a cardboard airplane. The use of non-cardboard material is kept to an absolute minimum while still maintaining structural integrity. In addition, the construction methods have been simplified for easy building. The aft fuselage is formed from a single piece of cardboard in one gluing operation and requires no bulkheads. The main forward fuselage is formed from two pieces of cardboard. Each wing panel is formed from a single piece of cardboard with one main spar. The empennage and all control surfaces are cardboard as well. Balsa strips have been used on the leading and trailing edges where streamlined shapes or smooth control surface action is required. Plywood has been used for engine and landing gear supports.

The term "cardboard" actually refers to corrugated fiberboard and is specified by test strength, facing weight, and flute style. In its usual form, it consists of an outer facing paper, an inner flute paper, and an inner facing paper. Test strengths are dependent on the weight of the three components specified in pounds — per thousand square feet. Flute sizes are B, C or A, which result in an approximate thickness of 1/8", 3/16" and 1/4", respectively. The material used for the Cardboard 500 is 1/8", 200 pound test, B flute, which is the heaviest weight of standard cardboard in this thickness. Manufactured cardboard can vary as much as 29 percent in weight. By using 150 pound test cardboard, a savings of almost 1/2 pound could be realized without compromising the structural strength. However, the flying qualities of the Cardboard 500 do not suffer with the use of the heavier 200 pound test board.

The Cardboard 500 is presented to show the basic building techniques and capabilities of cardboard and is offered as a club project for One-Design Races. It meets the design requirements for a Quickie 500 racer and is compatible with several existing Quickie 500 designs. Used as a club project, cardboard sheets could be stacked and pinned together and cut out on a jigsaw or bandsaw. Any comments or questions concerning the Cardboard 500 can be sent to Bob Miller at P.O. Box 1218, Artesia, Calif. 90701.

CONSTRUCTION HINTS

Glue: We recommend water based glue such as Wilhold or Titebond. Contact cement is not recommended since parts cannot be aligned when laminating surfaces. When laminating, weight components on a flat surface.

Folding: The scoring of the fold lines is done with a screening tool available at any hardware store. It consists of a handle with a 1¼" diameter radiused wheel at one end which is run along a straight-edge on the fold line.

Finishing: Cardboard gives a solid surface with no open areas to cover and is non-porous. The lightest, simplest and most inexpensive method is to give two coats of clear dope and two coats of color dope. However, a wide variety of finishing material can be used on cardboard. Coverings such as Solarfilm, MonoKote and vinyl paper can be used. With any of these, it is recommended that the surface not be doped, which will result in a better bond. Vinyl shelf paper is least expensive but incurs an additional weight penalty.

CARDBOARD 500
Designed By: Bob Miller

TYPE AIRCRAFT
RCM 15-500 Race & Gen. Sport
WINGSPAN
50 Inches
WING CHORD
10¼ Inches
TOTAL WING AREA
504 Square Inches
WING LOCATION
Low Wing
AIRFOIL
Symmetrical
WING PLANFORM
Constant Chord
DIHEDRAL, EACH TIP
1/2 Inch
O.A. FUSELAGE LENGTH
44½" (incl. spinner)
RADIO COMPARTMENT AREA
(L) 9¼" X (W) 2¼" X (H) 3"
STABILIZER SPAN
16½ Inches
STABILIZER CHORD (incl. elev.)
6" Average
STABILIZER AREA
96 Square Inches
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top Of Fuselage
VERTICAL FIN HEIGHT
5¾ Inches
VERTICAL FIN WIDTH (incl. rudder)
6 Inches (average)
REC. ENGINE SIZE
.40 cu. in. (sport .19-.35)
FUEL TANK SIZE
6-8 Ounces
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rudder, Elevator, Ailerons, Throttle
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Cardboard, Balsa, Ply
Wing ..... Cardboard, Balsa, Spruce, Ply
Empennage ..... Cardboard and Balsa
Weight Ready-To-Fly ..... 68-76 Ozs.
Wing Loading ..... 19.5 Oz./Sq. Ft.

CONSTRUCTION

Cut out all cardboard and wood parts using the template outlines. Be sure to note the direction of corrugation. Score and fold the cardboard parts as indicated on the plans.

Fin and Rudder: Laminate two fin pieces together. Add 1/8" x 1/4" balsa strips on the leading and trailing edge and round off. Laminate two rudder pieces together. Add 1/8" x 1/4" balsa at the leading edge only and round off. Seal the rudder trailing and bottom edges with strips of silkspan. Hinge the rudder to the fin with cloth hinges. Add 1/4" sq. balsa to the top of the fin and rudder and round off.

Stab and Elevator: Laminate two stabilizer pieces together. Add 1/8 x 1/4" balsa strips on the leading and trailing edge and round off. Make the left and right elevators from two pieces each, then add 1/8" x 1/4" balsa to the leading edge. Seal the elevator trailing edges with silkspan strips. Connect the elevators with a 1/4" x 5" dowel. Hinge the elevators to the stabilizer with cloth hinges. Add 1/4" sq. balsa at the tips and round off.

Fuselage: Glue the inner fuselage to the outer fuselage as shown in Figure 1. The inner fuselage is recessed 1/4" from the front of the outer fuselage. Install the 1/4" firewall in the recess in the fuselage nose and two laminated bulkhead pieces as shown in Figure 2. Laminate the inner and outer fuselage bottom pieces together and glue to the fuselage bottom as shown in Figure 3. Glue four 1/4" sq. balsa stiffeners to the inside of the aft fuselage as shown in the side view. Form the aft fuselage by bending the pattern on the score lines and gluing the overlapping sides together. Slide the aft fuselage into the forward fuselage and glue together as shown in Figure 2. Add the 1/16" plywood and hardwood wing hold-down blocks to the inside of the fuselage. Install the servo mount, consisting of 1/8" cardboard and 1/4" spruce pieces, to the inside of the fuselage. Cut the fuel tank cover from the top of the forward fuselage. Install two 1/8" plywood pieces to the inside of the fuselage under the cover, then attach the cover with 1/8" machine screws. Seal all exposed raw cardboard edges with silkspan strips. Cut out the 1/8"' cardboard from the fuselage bottom and install the 1/8" plywood main gear mount. Make the wire tailskid and attach to the 1/8" plywood mount with thread and epoxy. Glue the assembly in the cutout in the aft fuselage. Glue the fin and stabilizer assemblies to the aft fuselage. The canopy and headrest, which are optional, are attached with sheet metal screws.

Wing: The left and right wing panels are built separately. Build the wing spar by laminating two cardboard strips together and capping with 1/4" sq. spruce as shown in view A-A. Glue the spar to the inside lower wing surface and add ribs as shown in Figure 4. Wrap the top wing surface around and glue to the spar and ribs. Glue all wing creases, as well, on the inside. Add 1/8" x 1/4" balsa strips to the trailing edge. Cut out slots in the inboard rib for the plywood wing joiners. Cement the wing

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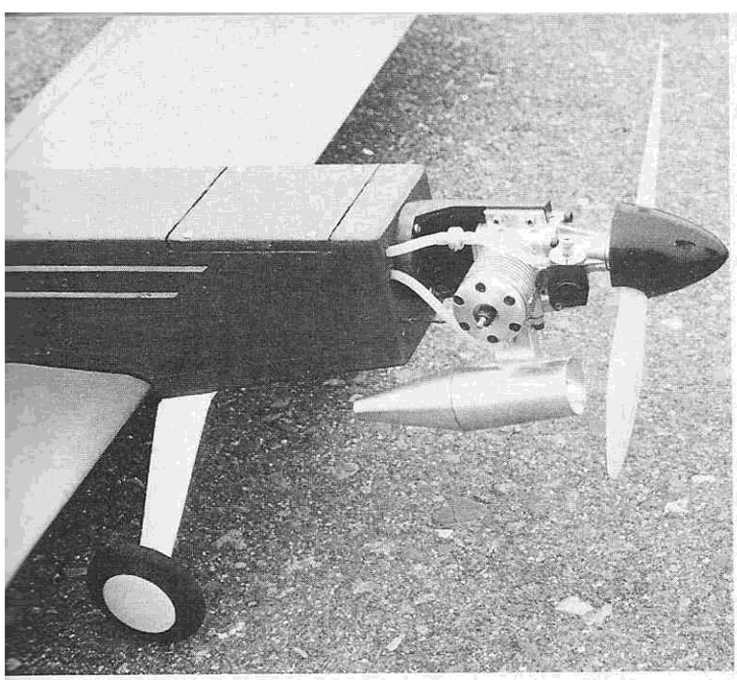

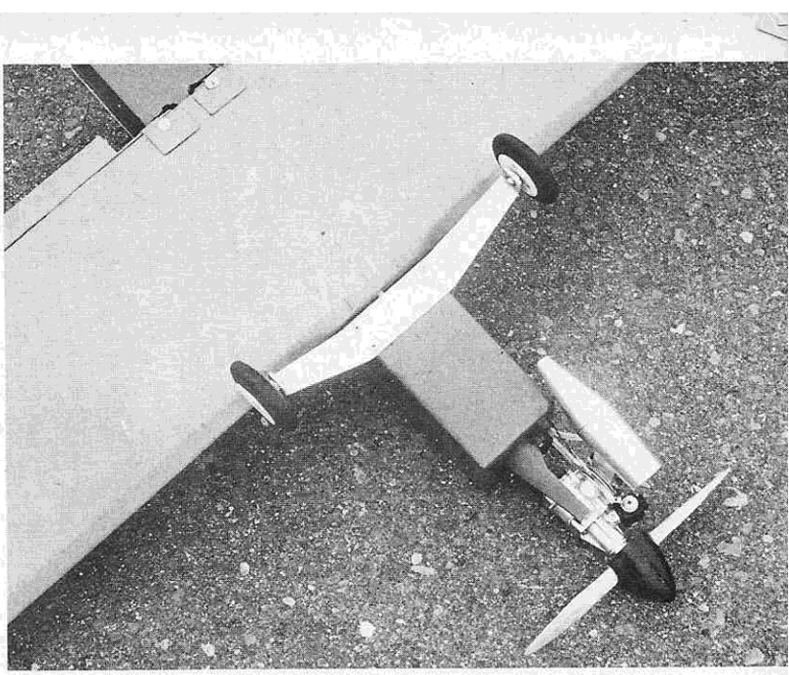

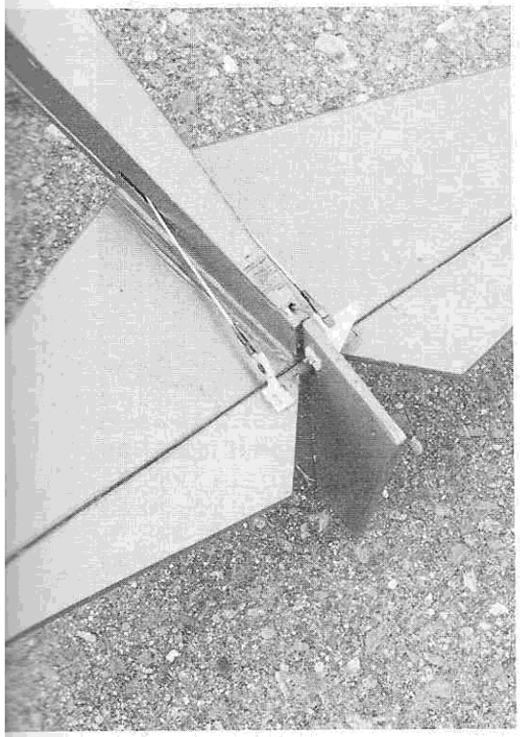

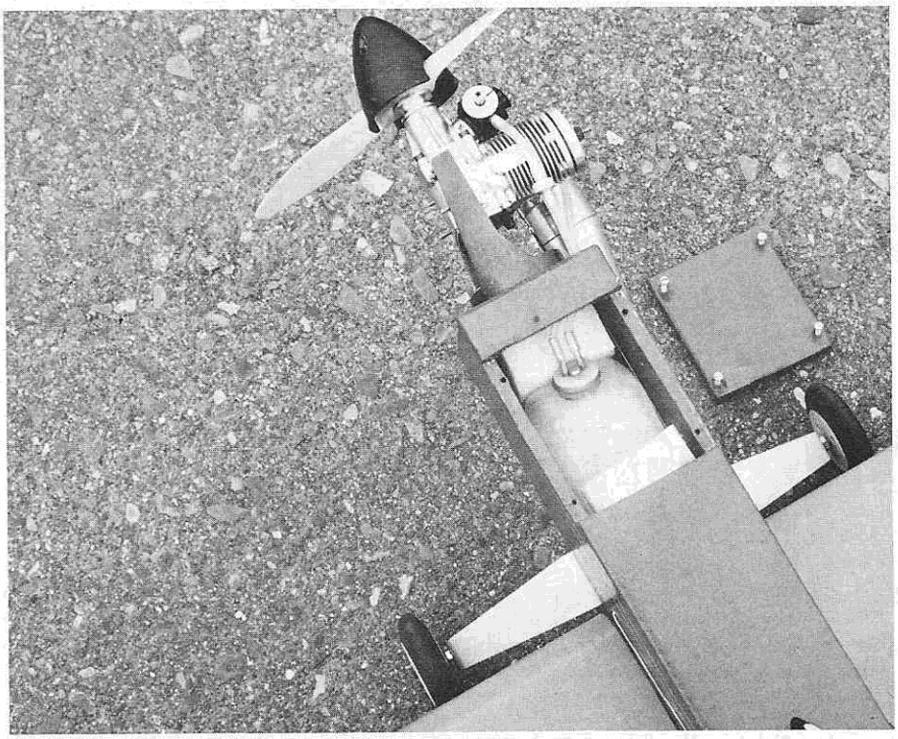

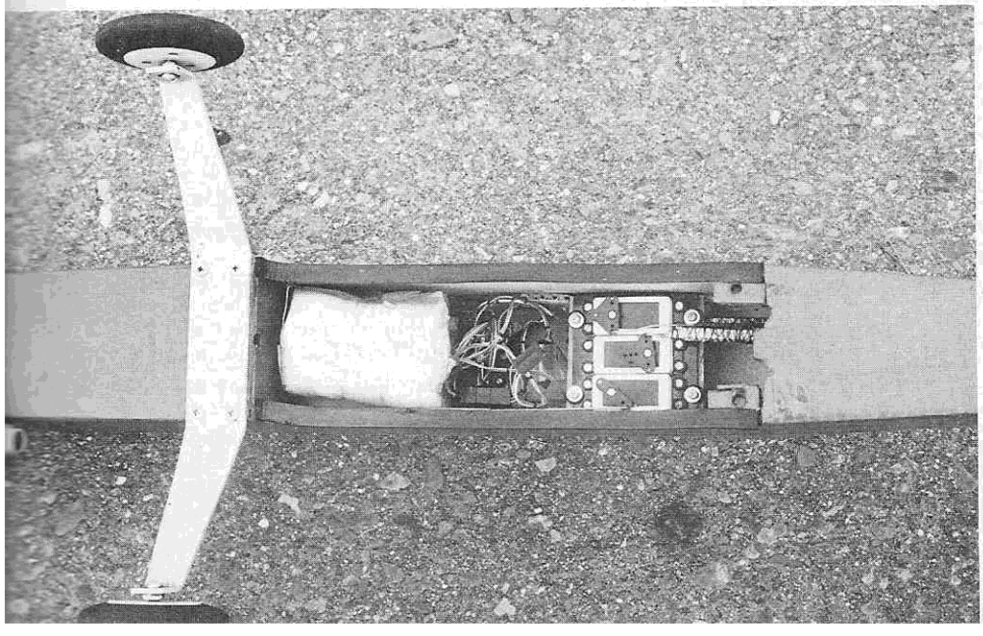

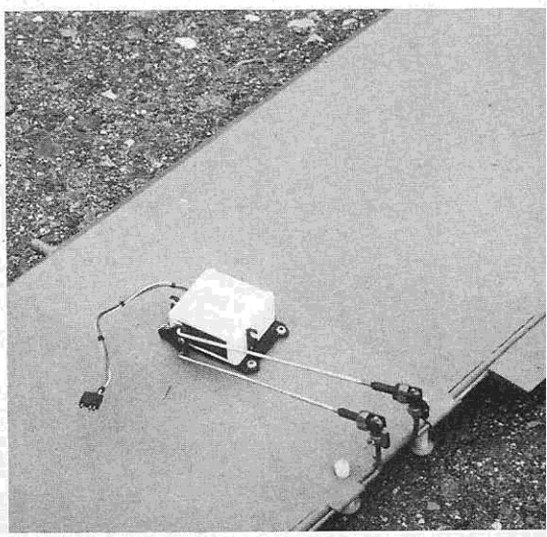

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panels together with plywood joiners using 5 Minute epoxy as shown in Figure 5. Reinforce the wing joint with tape. Add the 1/2'' balsa tips and round off. Make the ailerons from two 1/8'' cardboard strips laminated together with a 1/8'' x 1/4'' balsa leading edge. Install the strip aileron linkage and hinge the ailerons to the wing with cloth hinges. Cement 1/16'' plywood to the wing bottom and drill for the hold-down bolts. Drill and install the 1/4'' wing hold-down dowel in the wing leading edge.

Final Assembly: Install servos, battery, pushrods, bellcranks and fuel tank. Attach the engine and engine mount to the firewall. Install the main landing gear and wheels. Attach the wing to the fuselage with 1/4'' nylon bolts.

Flying

The Cardboard 500 is designed to compete with the Quickie 500 and RCM 15-500 .40 class racers. Thus, it is quick responding and fast. If you're not interested in this form of club racing, and want an all-around sport pattern aircraft, the Cardboard 500 will fit the bill with engines from .25 to .40. While most of us are reluctant to try new materials, we feel that you'll truly see the benefits of cardboard construction if you will take the time to build the Cardboard 500 and learn the techniques of working with this inexpensive and readily available material. □