

On the 'Wing...

# WINDLORD XE

Ken Bates' Standard Class 'wing gains ailerons and is enlarged to 128"

Ken Bates presented his Standard Class Windlord in the March 1978 issue of *Model Aviation*, the US Academy of Model Aeronautics (AMA) magazine. The 100" span model utilized rudder and elevator controls with the option of lower surface flaps. Despite what some perceive as shortcomings inherent in the plank planform, Ken campaigned the Windlord for a full season and came in third in the point standings.

The *Model Aviation* construction article devoted nearly half of its text to explaining how the plank planform works and how Ken resolved the problems evident in the preliminary designs.

Ken recently posted a build thread for the original Windlord on RCGroups < <http://www.rcgroups.com/forums/showthread.php?t=578473>> and plans are still available from the AMA as set number 215D. If you are an AMA member, the March 1978 issue of *Model Aviation* is available for viewing and printing through the *Model Aviation* archives in the "Members Only" section of the web site.

We've had our set of Windlord plans for more than twenty years, and in fact did build a 2M version with ailerons immediately upon receiving the plan set. That was in the days when we were building small gliders.

We've wanted to build an enlarged version with the FAI maximum wing area for some time, and after completing a joint building project with our younger granddaughter decided to start construction. Our hope is to have this monster in the air well before the Visalia Fall Fest in early October.

As is usual with our construction projects, we'll be incorporating some modifications to the airframe from what's illustrated within the original plans and described in the construction article.

Following a suggestion by Ken in his RCGroups construction thread, the rudder horn will be eliminated. We did this on our 2M version without adverse effects.

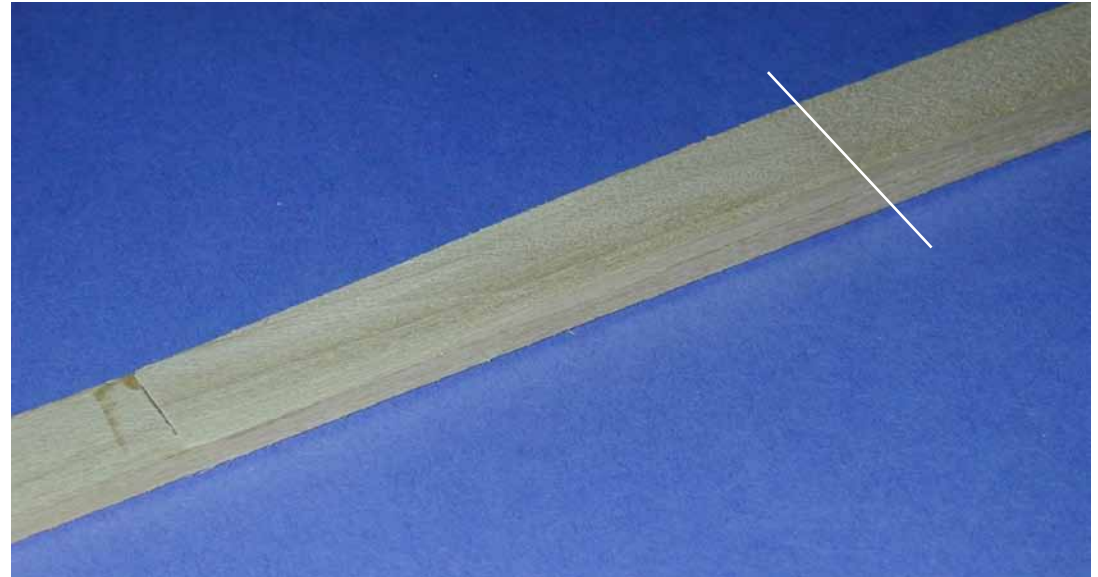
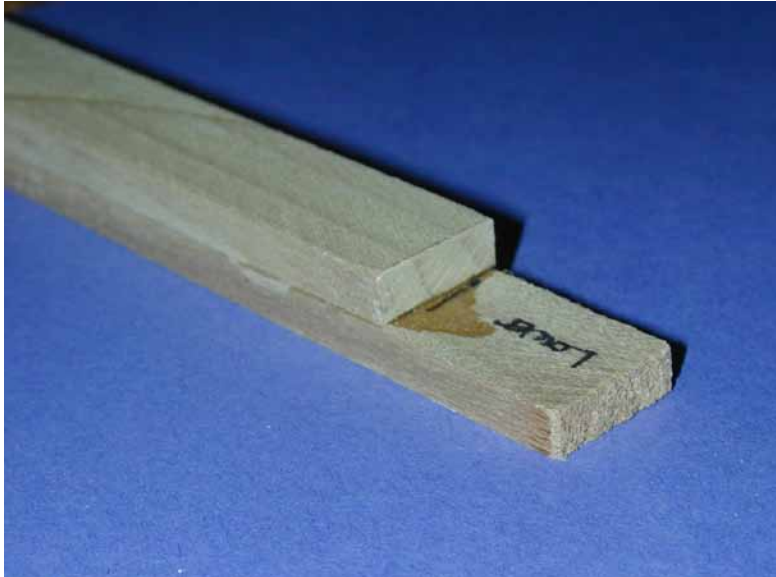
We'll be adding ailerons to this version of the Windlord as well, using the same

proportional span as on the Windlord 2M. The elimination of some rudder area is going to make it more difficult to inhibit adverse yaw without increasing rudder throw, so we've increased the aileron chord slightly to accommodate a Frise-type aileron structure.

Because of the deep fuselage, a bridle and two wing-mounted tow hooks are recommended. In his RCGroups build thread, Ken notes that the various commercial releasable tow hook mechanisms are no longer available. Ken custom-made a mechanism for mounting inside the fuselage for his RCGroups build. We'll use wing-mounted releasable hooks made from extruded aluminum stock.

The rudder servo will be mounted in the fuselage; all other servos (elevator, aileron, flaps) will be mounted within the wings.

This installment will cover the beginning of the construction process, including fabrication of the spar caps, forming the wing joiner rod, cutting out the ribs, and



*Example of typical spar cap. Left: The main spar is about an inch longer than the doubler glued to it. The extended*

*length will be cut off, but will be used to fix the spar to the building board during construction. Right: The spar doubler*

*is tapered over the last five inches to eliminate the stress riser. The taper starts in the area of the white line.*

designing and building the releasable tow hooks.

Let's start with the spar caps. Because they are 56" in total length, hobby shop spruce is too short. We traveled to our local Home Depot and picked up a six inch width of one inch poplar six feet long.

At home, we used various thicknesses of balsa sheet to set a slight angle into the board as it rest against the table saw fence. After running the board through the saw, we had a piece of wood 3/4" wide, six feet long and slightly greater than 1/4" thick at one end and tapering to near zero thickness at the other end.

By taping this piece onto the edge of the board in the same orientation, we were able to cut a second spar cap of the same dimensions. By exchanging the orientation of that first spar cap appropriately, we were able to cut a number of fairly consistent spar caps quickly.

After sawing up the entire board, we went through the caps and picked out two pairs of two identical caps. One pair, very slightly thicker than the other, is to be used for the upper spar caps, the other pair for the lower caps.

We then went through the caps again and picked another two pairs which

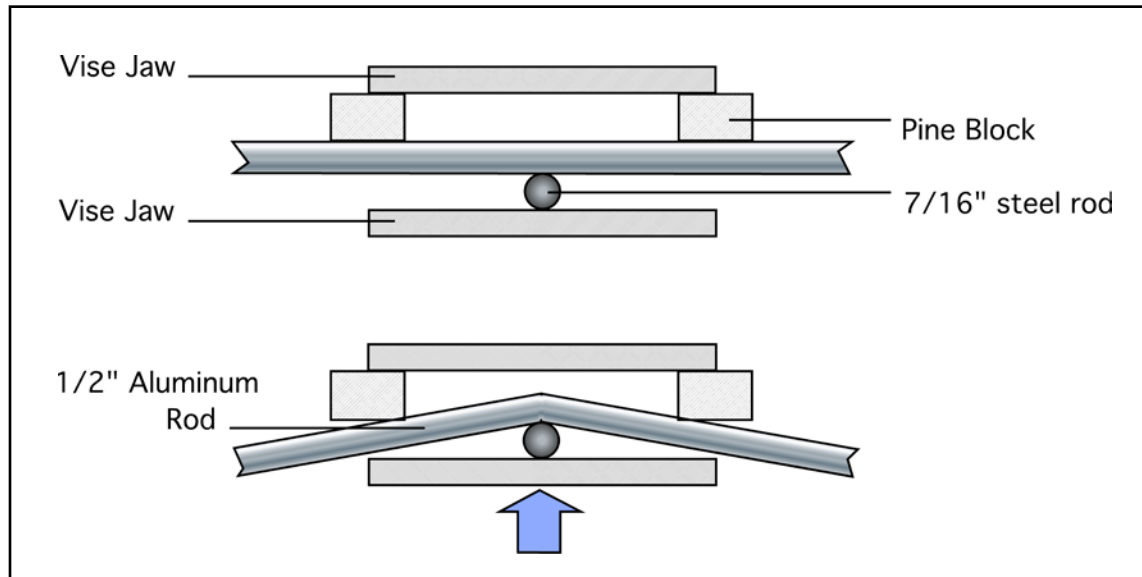
matched near the root. These four caps were cut off at a length of 20" and the last five inches tapered from the 1/4" thickness down to zero thickness. These serve as spar cap doublers at the wing root and are bonded to the full length spar cap with West System 105/206 epoxy using long steel blocks for pressure.

The original Windlord used a 1/4" music wire wing rod. This rod was straight and angled downward through the wing spar system so dihedral could be incorporated without bending the rod. For our XC version, the wing rod is a 16" length of 1/2" diameter ASTM-B-221 6061



*Above: The formed wing rod. The bend is sharp enough that a 1/2" inside diameter brass tube slides to within 3/8" of the center.*

*Left: Using a vise, pine blocks and a steel rod, the 1/2" 6061 aluminum rod is bent to the proper dihedral angle. Make sure the vise is of the "heavy duty" type, as pressing the angle into the rod takes a lot of force.*



aluminum bent so the angle provides 3/4" height at a distance of 5" from the center. This angle was bent into the rod using 3/4" pine blocks, 7/16" steel rod and a vise. The resulting bend is sharp enough that 1/2" ID brass tubing slides to within 3/8" of the bend point.

We're planning to affix the wing rod within the fuselage with a latching system so it can be removed and replaced with relative ease. Within the wing, the rod

is held by a 1/2" inside diameter brass tube which is a near match to the interior distance between the spar caps.

Unlike some of our other projects which required a large number of rib templates, there are only three different rib profiles for the Windlord. This makes rib template construction go quickly. The only additional wing part template is the one used for cutting out the ailerons.

All wing ribs are cut from 1/8" balsa sheet. The aluminum templates are notched for spar location, not depth, and so each rib will need to be notched for the appropriate spar cap depth. There are two sets of sub-spars — one which forms the trailing edge of the main wing panel in the area of the elevator, and one slightly forward of that which extends from the wing root out to the end of the aileron. The ribs located in front of the



Left: All of the wing ribs cut out — 22 “standard” ribs, two for the rib separating the elevator and aileron, a shortened

elevator have a 1/8" vertical slot for the aileron spar.

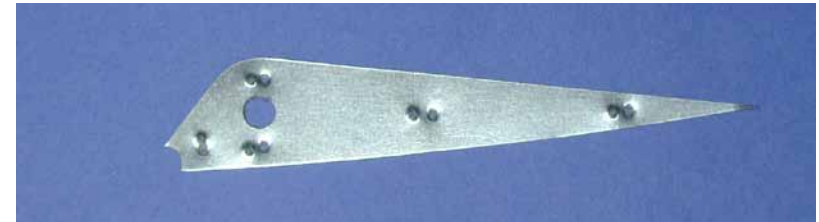
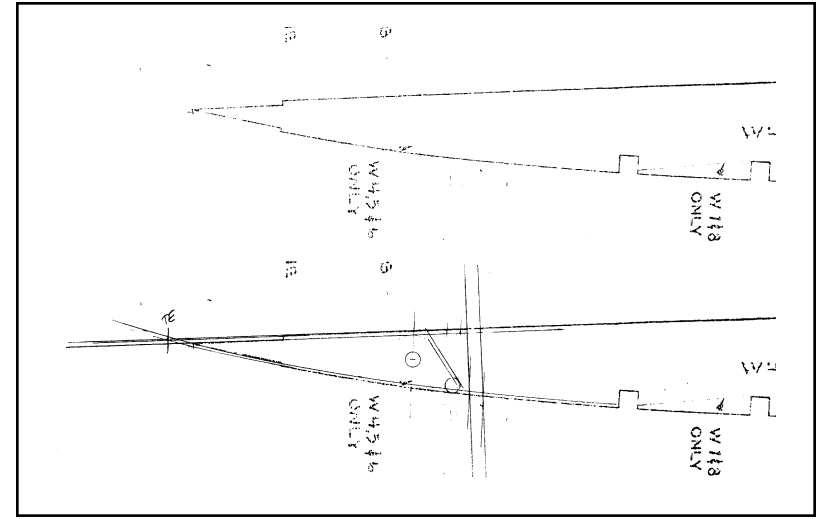
The template for the ailerons is a fairly simple affair in that it matches the contour of the wing trailing edge with incorporation of a rounded upper surface which matches a wiper built into the wing, and an angled leading edge which extends below the wing surface when the control surface is deflected upward. A 1/4" diameter hole is drilled in a spot

rib for the wing tip, and the D-tube ribs which extend from the leading edge to the spar. Upper right: The initial sketch

central to the upper surface curve for insertion of an aluminum tube which will act as the base for the hinge axle.

We built a small fixture out of pine blocks to assist in drilling the hole for the aluminum tube. This was set up in the drill press using the aluminum aileron template, then three or four ribs at a time were stacked up and drilled at the same time. Worked great!

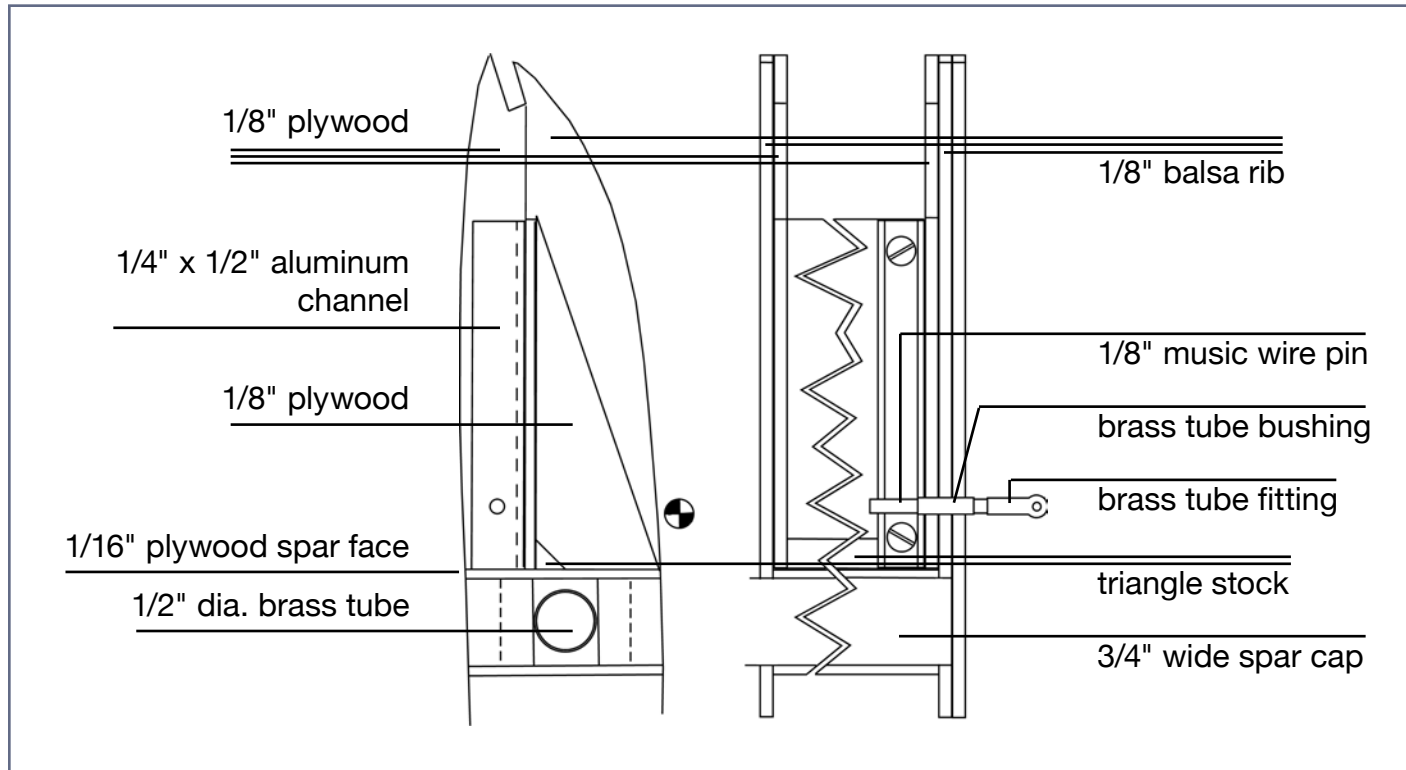
The releasable tow hooks are being



of the Frise-type aileron rib design. Lower right: The aluminum sheet aileron template.

constructed using extruded aluminum channel normally used to edge 1/4" plywood. This aluminum channel is relatively easy to machine and provides an internal width sufficient for the bridle tow ring. The channel is machine screw mounted to an internal structure consisting of plywood pieces bonded to the root rib and the front of the spar.

The “hooks” are made of 1/8" music wire, slide in brass tubing mounted in the root



*Diagram of the releasable tow hook. These units are mounted against the root rib on a plywood platform which extends across the bay to the second rib. The tow ring is released*



*Here's the aileron rib fixture mounted on the drill press and in use. It was set up with the metal template in place so the drill bit would hit the right spot. In this shot four ribs are being drilled at the same time. The consistency was worth the extra effort.*

rib structure, and traverse the width of the channel to enter a hole on the other side. In use, the tow ring is inserted into the channel slot and a servo pushes the music wire "hook" across the channel and trapping the ring. The servo simply pulls the pin back toward the fuselage to release the tow ring,

We'll be able to start formal construction with the completion of a few more items — the plywood servo mounts and wiring passages need to be installed in the appropriate ribs, for example.

More next month!

