

A rear quarter view of the real N1-M. The airplane changed shape frequently during its career as elevators, ailerons, elevons, dihedral and anhedral were altered during the flight test program. An interesting project for someone who wants to try out twin engines and retracts. Photo courtesy of Northrop Aircraft.

# NORTHROP N1-M

**One of the most unique aircraft ever built, the Northrop flying wing makes an equally unique and excellent slope soarer.**

**By Gus Morfis**

● This model of the Northrop N1-M is really the result of a number of different forces coming together.

First, the slope soarers around here began to develop along two broad paths; the highly refined, high aspect-ratio "Cirrus" types and the close-coupled highly loaded flying plank designs. Both have their place and their admirers, but to my eye the development potential was not there. About the most "improvement" possible was to change the shape of the vertical fin to something more stylish.

Second, my working at Northrop Aircraft developed my interest in Jack Northrop's flying wing designs. I don't think that anyone who has ever seen one of his Wings fly went away unimpressed. They seemed "right" and "natural" somehow, evoking that old saying that something which looks right will probably fly right, which

## NORTHROP N1-M

Gus Morfis

### TYPE AIRCRAFT

Semi-Scale Flying Wing

Slope Soarer

### WINGSPAN

72¾ Inches

### WING CHORD

Root — 22¼ Inches

Tip — 3¾ Inches

### TOTAL WING AREA

942.5 Square Inches

### WING LOCATION

Flying Wing

### AIRFOIL

Symmetrical

### WING PLANFORM

Tapered L.E.

### DIHEDRAL, EACH TIP

See Template on Drawing

### RADIO COMPARTMENT AREA

(L) 7" X (W) 6" X (H) 2½"

### LANDING GEAR

Ply Skid

### REC. NO. OF CHANNELS

2

### CONTROL FUNCTIONS

Elevator and Aileron

### BASIC MATERIALS USED IN CONSTRUCTION

Wing ..... Balsa & Ply

Weight Ready-To-Fly ..... 36 Ounces

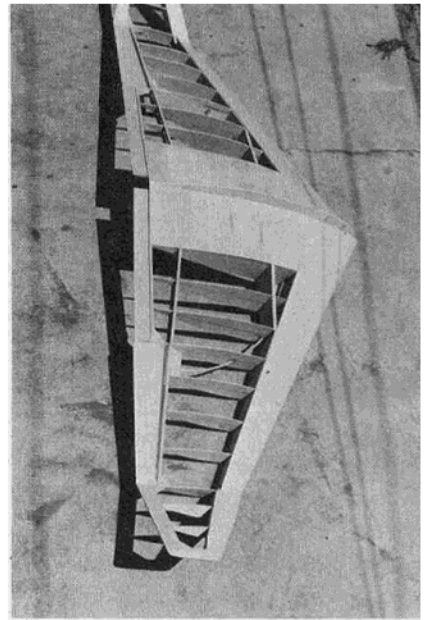
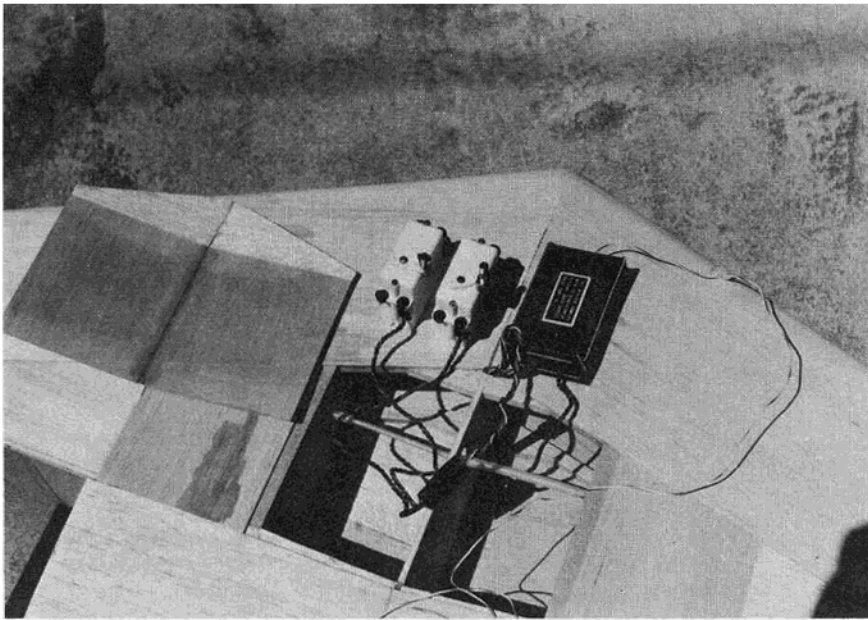
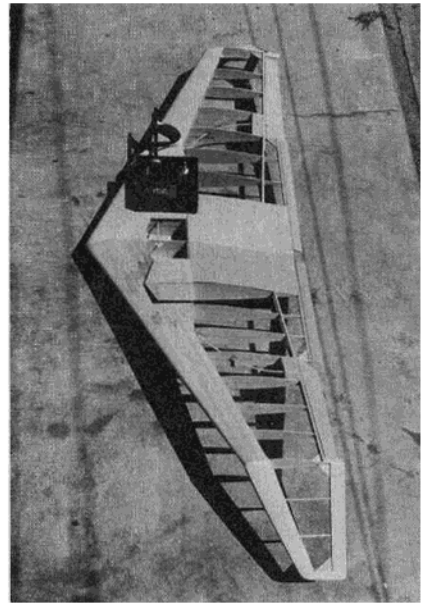
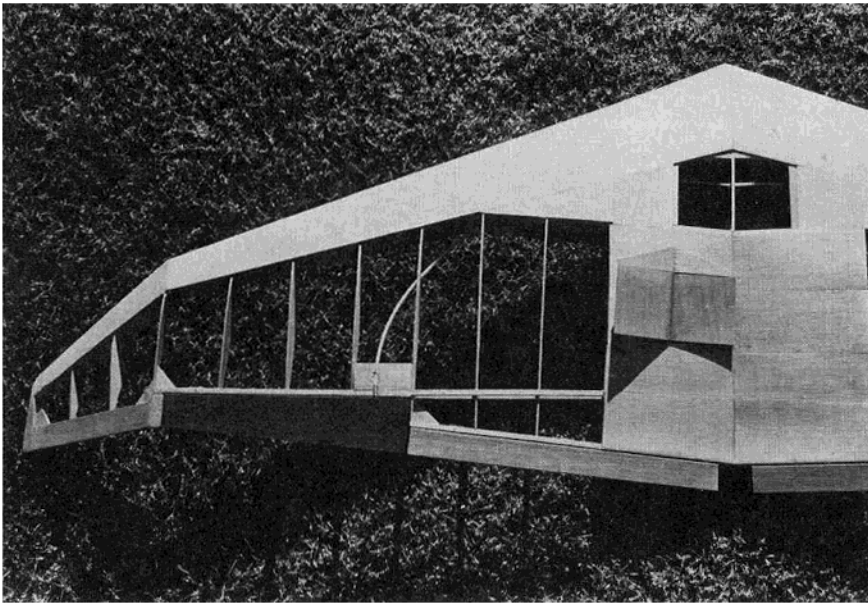
Wing Loading ..... 6.5 Oz./Sq. Ft.

apparently they did. I had long felt that the Jack Northrop's wing concept would have potential on the slopes. Its appearance would be distinctive; no mistaking these drooped tips and highly tapered surfaces for anything else around!

There is no vertical tail on this model and none is needed, since the toed-in drooped tips provided all the directional control the model needs. It is something weird to stand underneath the model and notice that there is not the slightest tendency to yaw or hunt. Aileron and elevator provide instant turns — in fact, there is a tendency to yank the model around. However, as soon as the controls are released, the N1-M settles into its new heading with no fooling around. Like most clean designs, this wing is fast, and the absence of fuselage and empennage drag is very evident.

### Construction

Our construction approach is novel but not difficult. Using the building jigs will result in your putting in the correct amount of twist, dihedral and tip-droop automatically, as well as holding everything steady while you install all the small bits. The absence of the fuselage and empennage makes the whole thing that much simpler to build, which means you can get out on the slopes



**TOP ROW, LEFT:** Top view of Northrop N1-M wing panel. Note servo compartment in center. NyRod linkage can be seen. **RIGHT:** Overall top view of complete N1-M structure. Orbit transmitter rests on center section. **SECOND ROW, LEFT:** View of radio compartment showing two servos and Orbit receiver. **RIGHT:** View of bottom of uncovered N1-M structure. Note plywood skid on center section of wing. **LEFT:** The Northrop N1-M flying wing riding the slope waves over the beach at Torrance, California.

... faster!

Please forgive the step-by-step building description which follows, since this is the building sequence which worked well for us, and I think it will work out for you, too.

First, you are going to need a flat building board 2 feet wide and 6 feet long; in fact, 3' x 7' would be even better. Rig it on some sawhorses or orange crates so you can get all around it, and make sure it is flat. Any warps in your board will be built into your wing.

When cutting out the ribs you might decide to build up some of the bigger ones — go to it — the price of balsa being what it is these days, you might find it worthwhile. Keep in mind that we are fighting a tail-heavy tendency and be careful with your glue and your lightening holes.

Next assemble each wing panel from rib #1 to #10, flat over the plans, gluing all the ribs in place to the spar caps and leading edge, except rib #1 and #10. Plank the leading edge on one surface only (this will eventually become the bottom surface). All the ribs are symmetrical (except #1) so you don't have any problems with "right-side-up" while installing them.

Remove the two floppy wing panels from the flat board and hang them up in a safe place. We now come to the unique part - - - the dihedral jigs. The two jigs can be cut out of any flat material available, corrugated box stock is really quite good enough, while Masonite or plywood isn't really any better, but it is more expensive. If you do go the corrugated route, I suggest you run the grain vertically and, if you can't find pieces long enough, piece together what you need from the boxes at hand, no sweat! Cut them out per the dimensions on the plan and crease the leading edge jig at each dihedral break point. The trailing edge jig doesn't need any crease at the center and just a little at each outboard dihedral break.

Install the jigs on the building board, over the plans if you prefer, (I don't), and gusset them with blocks and pins and glue so they stand up vertically. Now, if you have a good imagination, you will see what the basic shape of the glider will look like - - - it's weird!

Take your wing panels and set them into the jig **planked side down**. More than likely it will take some twisting and bending to get them to slide in. Put a few pins on the leading and trailing edges of each panel (at the center line of each rib) to keep the panel from falling to the bottom of the jig.

Trim and fit both panels at the center until rib #1 fits okay, then glue it in well, making sure that the rib is aligned vertically. This has set your dihedral angle.

The drooped tips can now be built onto your wing panels. I think the easiest way is to fit the leading and trailing edges and the tip rib first, then the bottom spar, the ribs and the top spar. The spar attachments at the dihedral break should be neatly done, for these tips take an awful beating during the landings!

Finally we get to the fun part, fitting the radio gear and the control runs. Our plans show the Heath GD-47 installed. This was one of their early efforts and the receiver is really a monster, compared with the newer gear available now. Put your gear as far forward as possible, since it will take the place of some of the ballast we will possibly need. Your control runs can now be let in, in any fashion you prefer. We show NyRods, but anything goes, whatever you are used to is the best.

The only things left to do is to fit your hatch opening as you require and to plank the spar web and the upper leading edge. Once you close up the leading edge "D" section, you will find that the required twist is built into the wing automatically.

Now for the big moment! Lift it off the jig and admire it - - - isn't it something else? Do you

think you will have trouble mixing it up with someone else's in the air? Not a chance! There isn't anything nearly resembling this wing design at all!

When you are done "playing aeroplane" it's time to get back to business. Plank the rest of the center section aft of the main spar. One of the real problem areas with this type of machine is tearing the bottom to shreds during a landing. There is no fuselage to take the wear and tear of grinding along the ground. The center skid takes some of the beating but there are still going to be rocks or sticks which jump up just as your glider comes in. This is why I recommend plywood for the bottom surface.

Well, that's all there is to it. Covering is strictly up to whatever you can work with best. Our model is covered with orange MonoKote up to the spar line and white all the rest of the way. We used a thin black line to separate the two colors. We wanted high visibility and this seemed nice. You might find that you have trouble spotting whether the model is coming toward you or flying away. A contrasted colored panel on one wing panel or wing tip might help. We relied on the difference between orange and white for our visual orientation.

#### FLYING

Balance the model about 1/4" forward of the position shown on the plans for the first couple of flights. Trim the ailerons about 1/8" up to start with and adjust this amount as you need to get a good smooth flight path. Then gradually move the C.G. aft as you get more experience with your N1-M.

We had no problem snagging wing tips as long as we came in level. Thanks to its great stability this was mostly the case, but if you find yourself coming in one wing low you might as well expect to cart-wheel on your landing approach! Maybe you more experienced builders will want to make some sort of a knock-off wing tip arrangement, so go to it, but watch your weight!

#### COMMENTS

You braver souls might care to experiment with a different airfoil section. The symmetrical shape we have used works well, but like most reflex shapes, is a bit of a bear to cover over. I, personally, am not convinced that the reflex really helps that much at these sizes, so you might consider a straight line from maximum rib height back to the trailing edge.

For you purists, I must mention that the skid on rib #1 is there as an aid to launching only (there is no way to hold the model without it). If you can come up with some other way of launching the model — go to it — but remember to use some Celastic or fiberglass on the bottom to protect it.

After watching this model fly and studying its characteristics, I am convinced that the wing tips can be reduced by one bay. The model's directional stability is so positive that I am recommending this modification to Nick, who built the model you see in the pictures.

In closing, I must thank Nick Nickolin for having faith in my design and the conviction to carry it through. M.G. (Jerry) Hubin is the fellow who wrote an excellent article in our club magazine on how to balance flying wing designs and gave me much valuable advice on the subject. Thank you, Jerry! And to "Johnny" Johnson who flew in some of the real flying wings, but now flies R/C, a special nod of appreciation for his comments and suggestions. □

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