Companion Guide: "Building Fly Baby"
Article 10: Miscellaneous #2

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and the Fly Baby Community

This Companion Guide is written to accompany the tenth of Pete Bowers' Fly Baby construction articles in EAA SPORT AVIATION magazine. Articles 9 and 10 didn't have a subtitle, but they can best be described as "Miscellaneous Topics." So this is Miscellaneous #2.

You will need to download these articles from the EAA Archives. This Companion Guide merely supplies additional background information and some helpful hints on the actual construction. A full Table of Contents is included on the next page.

Photo by Jim Katz

There are two kinds of figure references in this Companion Guide. If the reference is "Figure 1-1" (with a hyphen), it's a figure in the original EAA articles. Figures without a hyphen are contained in this document and should closely follow the text which refers to them.

For specific assistance in building the components described, see the Workmanship and Hardware articles on the PB100 Web Page.

Many thanks to Matt Wise, Jim Katz, Jim Hann, William Beauvais, Olan Hanley, Harry Fenton, Bill Hills, Drew Fidoe, Hans Teijgeler, Charlie Gay, and the others of the Fly Baby community for providing some great pictures to illustrate the points in this Guide.

TABLE OF CONTENTS

List of Figures

1 OVERVIEW

Magazine editors don't like excessively long articles. Most of the articles in Pete's construction series are three to five pages long.

At some point, Pete had to talk about, basically "other stuff." Stuff that wasn't structure, or controls, or engines. He needed six or more pages to talk about subjects like the turtledeck, flooring, wheel brakes, windshields, etc. No one subject really justified an individual article, and a long series of short articles probably didn't make much sense, either.

So Pete divided these miscellaneous topics into two separate articles, in November and December, 1963. This Guide covers the topics addressed in the second article, in December.

Photo by Jim Katz

1.1 Note about Illustrations

To make things clearer, I have drawn up a lot of sketches to illustrate some of the aspects of the assembly. Peripheral details on these sketches are just there to complete the drawing—they may not, exactly, match the original Pete Bowers figures. My sketches always are in color; Pete's are black and white.

Where there is a difference between my sketches and those from the Pete Bowers articles, assume the original article sketches are correct.

If two pieces in my sketches are supposed to be the same size but look different, just assume that was an error.

1.2 Workmanship

Let's review the Basic Workmanship rules for building Fly Babies. Key notes:

- Do not varnish any areas which will subsequently be glued
- Varnish any closed areas (double-plywooded forward section, etc.) before they are closed up.
- Drill holes in wood directly to size, using a brad-point drill bit
- Varnish all bolt holes
- Varnish all areas where metal parts will be in contact with the wood
- All metal components should be painted or otherwise protected.

2 ERRATA

Everything in these articles are pretty minor stuff. Not much scope for mistakes in the original articles, though I'll talk about potential problems in the individual articles.

2.1 Flying Wire Size

One recommended change is upgrading the forward flying wires on the wing. The flying wires are the cables under the wings that support all the weight of the aircraft in positive-G flight, while the Landing wires are on top of the wings, and support the wings on the ground as well as any negative-G loading. All are 1/8" cable.

However, the front bracing wires must handle about 60% of the flight loads. In some cases, folks have upgraded to 5/32" cable on the front wires only.

Note that this will also require going to the next larger turnbuckle size, as the original turnbuckle would then be the weak point in the system. The AN130-32 series is probably the best pick, though of course the price is higher. On the plus side, only four are needed.

However, if you're using the stock wing-brace system, the wing wire anchor plates might not provide enough clearance to install and remove the clevis pin for the turnbuckle (Figure 1). The bigger turnbuckles use longer clevis pins.

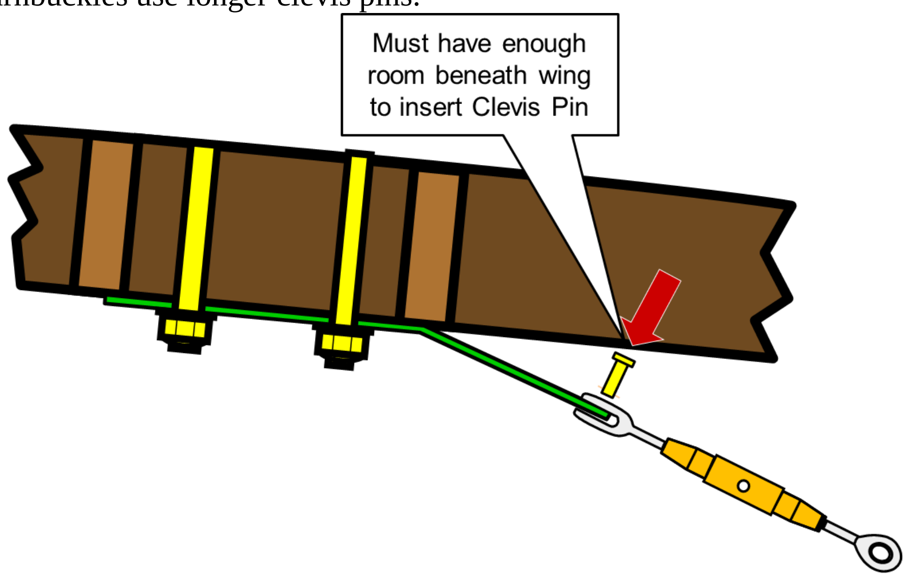

Figure 1: Clevis Pin Clearance

You can use the stock plates by attaching the fork end of the turnbuckle before the plate is bolted to the wing. The barrel of the turnbuckle then just screws into place. However, should you ever want to replace the wire or the turnbuckle, the entire anchor plate will have to be removed.

If you've used one of the alternate wing-wire bracing systems described in Guide #1, you should be okay…the pins insert horizontally, in these setups.

2.2 Baggage Door Size

One item added in this phase is the aft turtledeck. Its front bulkhead (right behind the pilot's shoulders) includes a door into the baggage area above the plywood sheet atop the fuselage frame.

Article 10, Figure 6-15 shows a small door into this area. Don't know why Pete put in such a small door…perhaps it was similar to one in another airplane he owned. In any case, there's no reason on Earth to make the door so tiny. Make it so it's most of the area, as shown in Figure 2.

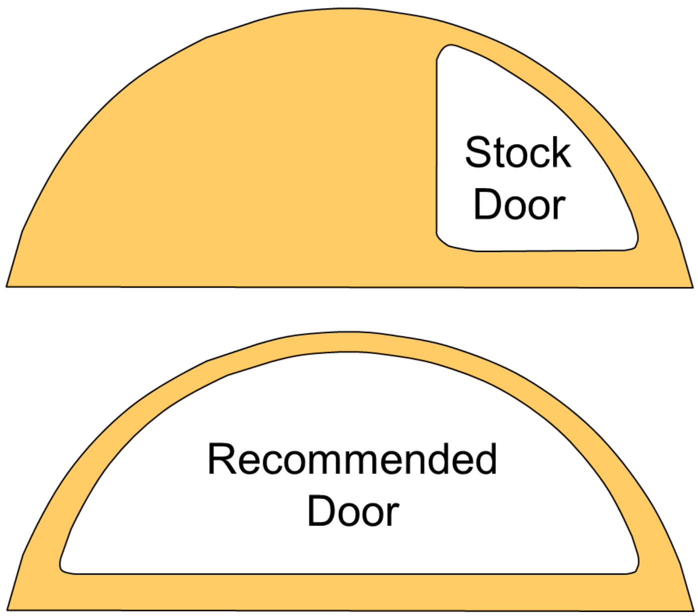

Figure 2: Baggage Door Size

Even Pete later acknowledged the door was unnecessarily small. In later issue of the plans, he sketched an enlarged door on Figure 6-15 and added a note that said, "The access door on the original Fly Baby was built as shown; for convenience, increase size as shown by dotted lines."

At some point in its life, N500F was even modified to have the bigger door. Curiously, my own Fly Baby (built in 1980, which I purchased in 1996) had the little door. Believe me, it's practically worthless. First thing I did when I bought the plane was modify it to add a larger door.

2.3 Headrest Center Brace

The lower part of Figure 6-15 shows the design of the separate headrest that gets installed atop the aft turtledeck.

The design shown is wrong. It has a center brace across the bottom, but because the headrest is being installed on an arced turtledeck, it won't work!

Like Figure 3 shows, that brace actually has to be curved to work. I'd just cut a piece of 3/4" wood (spruce, etc.) into the right shape.

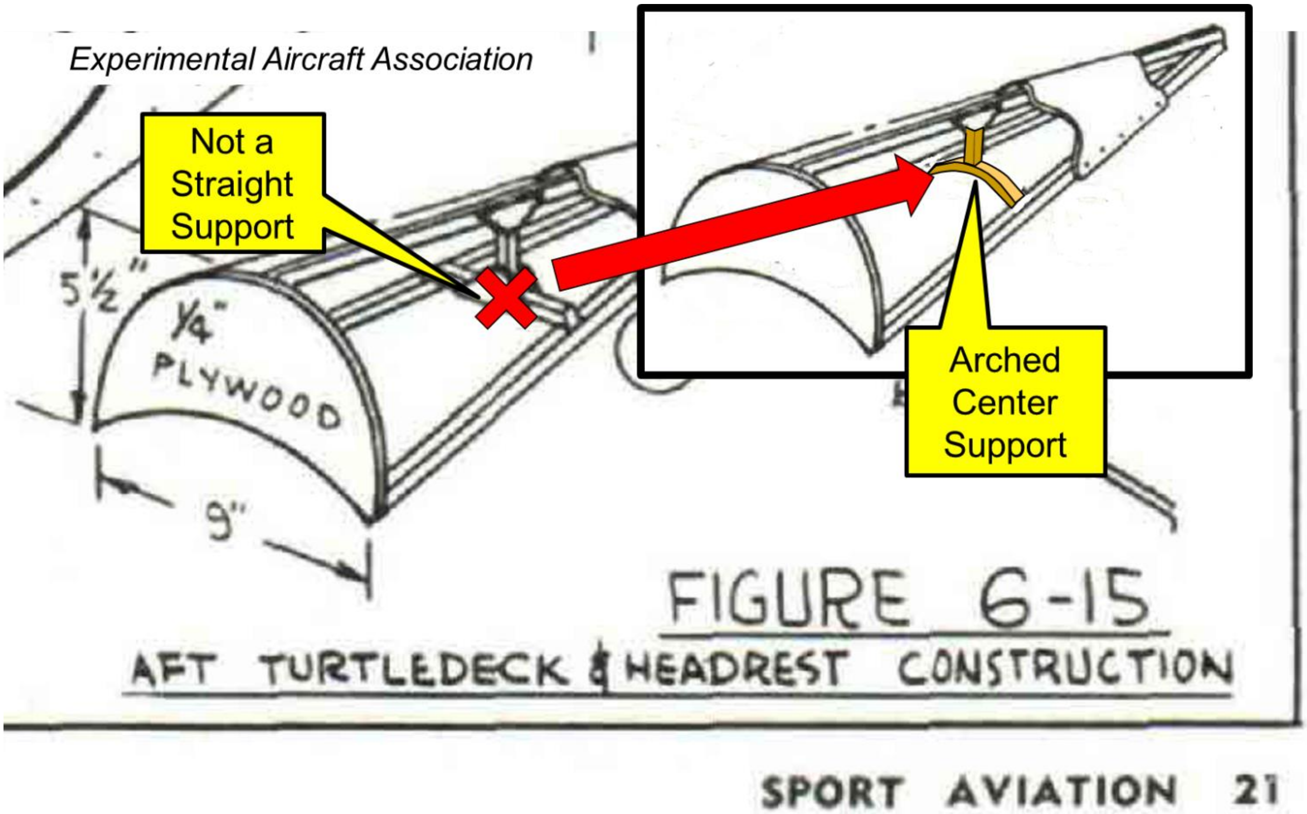

Figure 3: Headrest Brace Correction

3 SAFETY ISSUES

The issues related to the stock wing bracing system were extensively addressed in Guide #1. By this point, your wing is built, so there's no reason to cover them again.

4 CONSTRUCTION ISSUES – ARTICLE 10

4.1 Windshield

When it comes to the windshields, Fly Baby builders have two sets of two choices.

4.1.1 Windshield Style

The first choice: Should you build the stock three-piece windshield or go for a wrap-around type (Figure 4)?

Figure 4: Windshield Types

I prefer the stock windshield. It's a bit of work to make, but when one of the panels needed replacement, it was a breeze. Remove the bad panel, lay it atop a fresh sheet of flat Lexan as a pattern, trace out the shape, and mark the bolt holes. Then it just has to be cut out, the holes drilled, and re-installed. Took just an evening...and I kept the old windshield pane for a pattern so I could make new panes in the future without having to disassemble the windshield.

There are two approaches to a curved windshield. The first to install a windshield that's molded to fit. You'd either have to find an off-the –shelf unit or mold one yourself.

The second was used by Drew Fidoe. He just "Flat Wrapped" his windshield…installed the usual aluminum brace across the bottom then, cut the proper shape from 1/8" Lexan, and wrapped the Lexan in place (Figure 5). It's not molded; if one unbolts it, it just pops flat again. Makes it easy to cut a replacement, if needed.

I'm kind of half-surprised that this works, but it <u>does</u>. Drew's been flying with it for over ten years.

Figure 5: Drew Fidoe's Windshield

There is another option: A Lexan windshield formed using a bending brake. This basically creates the standard three-panel design out of a single piece of Lexan. It takes advantage of how tolerant Lexan is to bending.

I know it's been done, but can't give any particular advice on the process.

4.1.2 Windshield Material

Which brings us to the second issue: What material should you make your windshield from?

You basically have two choices: Plexiglas and Lexan. Back in August 2005, Don Glewe posted a good explanation of the two types:

Both are trade names --like Kleenex or Puffs-- for two different types of plastic: polycarbonate and acrylic. Both are available in many brands.

Plexiglas is **ACRYLIC**. it is harder and therefore more brittle, making it tougher to cut/machine --you can still do it, as long as you're careful and use fine-toothed blades and be careful not to feed it too fast. Holes can be drilled safely by merely relieving the "corners" on the ends of the bits so they don't grab. it is easy to heat form: a handheld air heater can be passed over the desired bend location, and a pretty decent bend can be formed by draping the sheet over a half-mold or just clamping the sheet to the edge of a workbench and letting it fall onto a board held to the desired angle.

Downsides: it scratches easily --but can just as easily be sanded/polished. The biggest con is that it will shatter/break into nasty sharp pieces if broken --dunno if I'd want that in front of me.

Lexan is **POLYCARBONATE.** It is "softer"…that makes it easier to cut/machine, because it won't chip as much. It also makes it good from an impact protection standpoint, because it won't shatter as easily as acrylic --I forget exactly, but I think 1/8" of the stuff will stop a 22-round. The downside comes from the same softness: polishing out/removing scratches in polycarbonate is a nightmare! It is also harder to heat form --so if you go with a one-piece you'll probably end up having it done by a company with a big enough oven to heat it consistently.

Telling the two apart --if they don't say what they are on the label-- can be done by looking at the sheet edge: poly will look dark, acrylic light or "clear". You can also whip out a pocketknife and try to carve a little sliver off the edge: poly will peal up like a soft wood/metal, while acrylic will be very resistant and may only chip/flake.

4.1.3 Selecting the Material

Both have advantages and disadvantages. But I vote Lexan.

Why? Well, Lexan has two disadvantages. It scratches a bit easier than Plexiglas, and it doesn't tolerate fuel spills as well. That's one reason I need a new windshield; I spilled a bit of gas on the old one years ago and it got a bit wavy. Only near the bottom in one spot, but as time went on, the windshield looks like it's becoming crazed around that location.

The advantages of Lexan? One great big one: Unlike Plexiglas, Lexan doesn't break.

This isn't much of an operational advantage (if you're encountering .22 caliber rounds in flight, you've got BIGGER problems than a windshield), but it's a big baby blue plus when you cut and drill it. Forget the special drill bits, forget the special sawing techniques. Just run the Lexan pane through the bandsaw (or even saber saw), and drill the holes with a conventional drill.

You'll find a lot of helpful advice for cutting Plexiglas; comments about how to modify drill bits to cut it, and how to minimize the potential for breaking when you cut it. Plexiglas will develop networks of cracks if not worked with the proper tools.

But Lexan? Cut it on a bandsaw, smooth the edge on the benchtop belt sander, pop the holes with a hand drill. Beat it, abuse it, whang on it. It just doesn't care. Some folks even use a bending brake for a one-piece paneled look.

Another plus...Lexan is common. You can buy it at Home Depot. In fact, the 2'x 4' sheet they sell is enough for two or even three windshields.

Yes, Lexan will scratch easier and need replacement more often. But Lexan is cheap, and if you go with the three-piece windshield, you can easily replace the panes every couple of years if you want. Just remove the old pane, trace out the outline on a new piece of Lexan, cut it with a bandsaw or saber saw, match-hole-drill the bolt holes, and mount the new pane. $100 from Aircraft Spruce or Wicks will buy you a lifetime supply of Lexan for windshields.

4.1.4 Constructing the Windshield

Pete’s instructions are pretty clear. You set up the sample windshield shape, cut the panels to match your desired slope and the curvature of the forward turtledeck, and drill and bolt it all together.

Probably the biggest thing: Don’t drill the holes in the turtledeck until you are satisfied with the windshield! The Lexan and the aluminum brackets are cheap and easy, compared to having to re-make the forward turtledeck.

4.1.4.1 SHAPING THE PANELS

Using cheap, easy-to-shape materials to develop your windshield is a good approach. Figure 6 shows Jim Katz's windshield design in progress, using some bent cardboard for a sample frame and a sheet of cardboard simulating the front windshield.

Figure 6: Developing the Windshield Frame

Cardboard's a good choice, or you might consider "foam core"…it's sold at hobby shops, and it's a sheet of foam sandwiched between heavy paper. It cuts and shapes easily.

Figure 7 shows Jim's windshield panels temporarily clamped, propped, and taped in place. This is Jim's final fitting using the Lexan, but you could do the same with foam core to ensure that the panels join properly and the windshield has the shape you want.

Figure 7: Windshield Panels Temporarily in Place

4.1.4.2 MAKING THE FRAMES

As Pete’s article shows, you’re going to frame the windshield in thin aluminum, to hold it together and to allow you to bolt it to the forward turtledeck.

For the portion of the frame on the bottom of the windshield, you’ll need to take good measurements, then build little forms to hold the aluminum while you bend it. There are three kinds of bends. One has gentle curves and a flange to attach to the fuselage, the second has straight, shallow bend to attach to the intersections of the three panels, and the final is a wrap-around “U” shape for the exposed edges of the Lexan.

Working with aluminum so far, you might be a bit concerned…how can you make some aggressive curves without the aluminum cracking or fighting the bending process.

The key is a word Pete uses to describe the aluminum to use: “Soft”.

All metal is tempered to various degrees before use. You’re used to seeing aluminum designated as 2024-T3 or 6061-T6. The “T3” or “T6” refers to the temper.

"Soft" aluminum has no temper…so you'll be looking for 2024-0. That's right, no "T", just a zero to indicate it hasn't been tempered.

Pete calls for 0.020" metal, and that's probably a good choice. Pete doesn't actually specify the allow (2024 vs. 6061), but the latter would have still been a bit rare in his day. So I'd use 2024.

Figure 8 shows how this soft aluminum wraps around the edges of the Lexan to make a U-Shape. In this case, the soft aluminum had been bent a full 180 degrees.

Figure 8: Edge Frames on Lexan

4.1.4.3 Assembly

Figure 9 shows Jim's windshield during assembly. Note the "U" shaped pieces of aluminum on the top of the windshield panels, and the angled pieces that actually join the separate Lexan pieces.

Figure 9: Partially-Assembled Windshield

Pete specified 3/32" machine screws to hold the metal to the Lexan. When I replaced the windshield on N500F, I used #6 machine screws with fiber locknuts.

How many bolts? Pete doesn't specify. Every three-four inches is probably sufficient (Figure 10).

Figure 10: Windshield Attachment

4.1.5 Drilling the Bolt Holes - A Caution

One warning, especially if you use Plexiglas: Drill the bolt holes slightly larger than the fastener size, and DON'T completely tighten the bolts to the plastic panel.

Plastic has a different coefficient of thermal expansion than metal. When the plane sits in the sunlight, the plastic will want to grow larger (Tony Bingelis says a 24" square sheet will lengthen by about 1/8"). If the holes are exact size, or the bolts are tight, it can't expand and stresses are induced. See Bingelis' "The Sportplane Builder."

4.1.6 Final Installation

When you make the lower flanges, drill the holes for attachment to the turtledeck 1/8”; as a pilot hole.

When you have the complete assembly, put it in place and carefully adjust it so it's exactly where you want it. Mark and drill one of the 1/8" pilot holes on one side. Install a cleco, and drill the corresponding one on the other side. Put a cleco in it as well.

Check again to ensure that the positioning is where you want it. If not, use another set of holes to drill and install clecos.

Then drill the holes to the final size. You'll want to install anchor plates in the forward turtledeck to allow removal and re-installation of the windshield. Use very flat rivets (driven or popped) to install these anchor plates. Or you could even use the anchor plates that accept dimpled metal to use flush-type rivets.

The plastic will have come with protective paper or plastic. I'd leave that on for now….

4.2 Cockpit Coaming/Rear Turtledeck

When you built the fuselage, you included a baggage shelf between the Station 5 bulkhead and Station 6 (Figure 11). This area needs to be covered, of course. Pete designed a removable rear turtledeck (area behind the pilot) and cockpit coaming (alongside the pilot) to handle this area.

Figure 11: Rear Turtledeck

4.2.1 Why Removable?

Now, mind you, it didn't have to be built so that it's removable. Most homebuilts like the Fly Baby install a permanent bulkhead behind the pilot's shoulders and run the top-of-fuselage stringers all the way to that bulkhead.

Why did Pete do it this way? Several reasons. First and foremost, Pete wanted to be able to convert from open cockpit to a closed cabin at will.

He could have designed the plane for a canopy and just left the canopy off, of course. I think time pressure (to get the plane ready to enter the contest) drove the open-cockpit approach. Plus, of course, Pete had plenty of experience in open-cockpit airplanes and saw nothing wrong with baselining the plane without the canopy.

While a number of Fly Babies have been built closed-cabin, few of them actually take advantage of this "convertible" approach. Matt Michaels is the exception; he developed a canopy adaptation fully in the spirit of Pete's original design; it is able to be swapped out for a conventional open-cockpit setup in a few minutes (Figure 12).

Figure 12: Matt Michael's Canopy Design

Matt was kind enough to write up the process for the Fly Baby web page, you can find his account at:
http://www.bowersflybaby.com/tech/canopy.html

Several other builders have used this system.

Matt's design is a "throwover" type; the canopy is hinged on the right side and hangs to the side when it's open (Figure 13). Many builders want a sliding canopy, a bubble like the WWII fighters had.

These are *much* more complex to make. You have to find the right kind of rails, the rails have to be installed parallel to each other, and, hardest of all, you have to find the proper sort of "bubble". The latter is tough…and when you do find them, they're pretty expensive.

There have been Fly Babies built with bubble canopies, but very few and I have no information as to their construction.

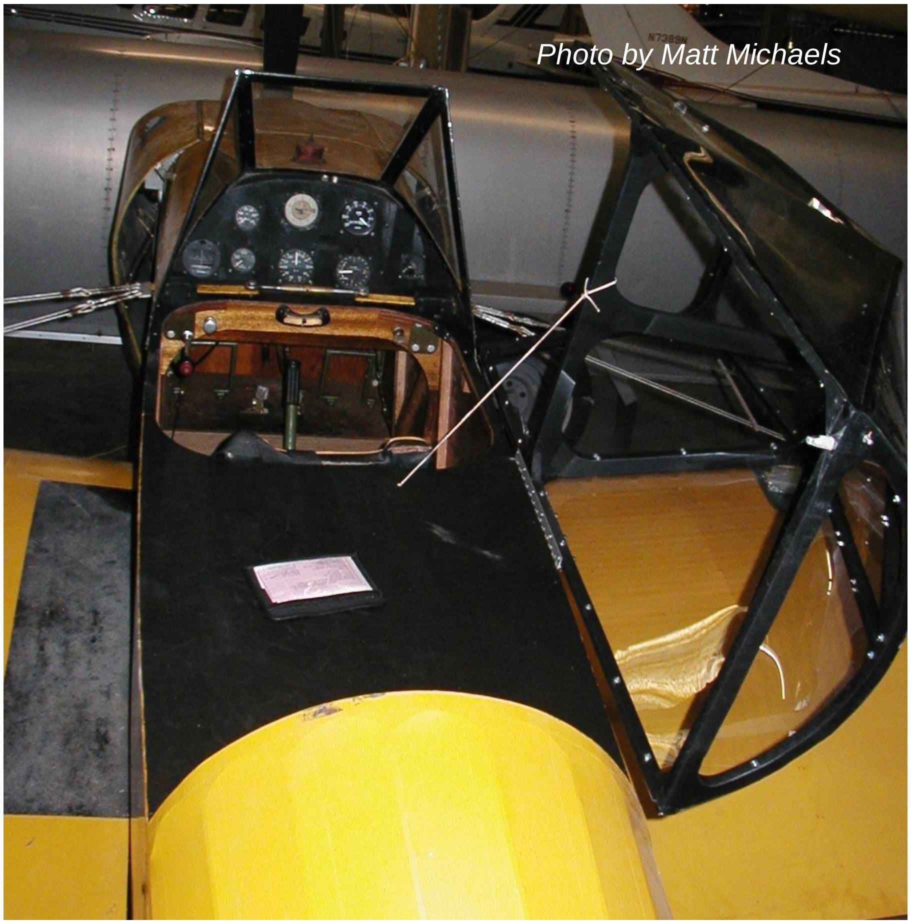

Figure 13: Michaels Canopy in Open Position

4.2.2 Design

The basic design of the turtledeck is a wooden frame covered in ~0.020" aluminum. The structure combines a base that matches the top surface of the upper longerons with two bulkheads; one at the front (just behind the pilot's shoulders) and one at the back (matching the shape of the top bulkhead at Station 6. These actually consist of "formers" (plywood sheets, 1/4" in front, 1/8" in back) and bows.

Two pins stick out the back of the turtledeck; these go into matching holes on the Station 6 bulkhead. It's not shown in the diagram, but small buckles hold the front of the turnbuckle down in front.

Figure 14 shows the basic concept of the turtledeck. Not shown are the reinforcements around the coaming; these will be addressed in a little bit. Note that the 0.020" aluminum that covers the structure actually overlaps the aft fuselage behind the turtledeck.

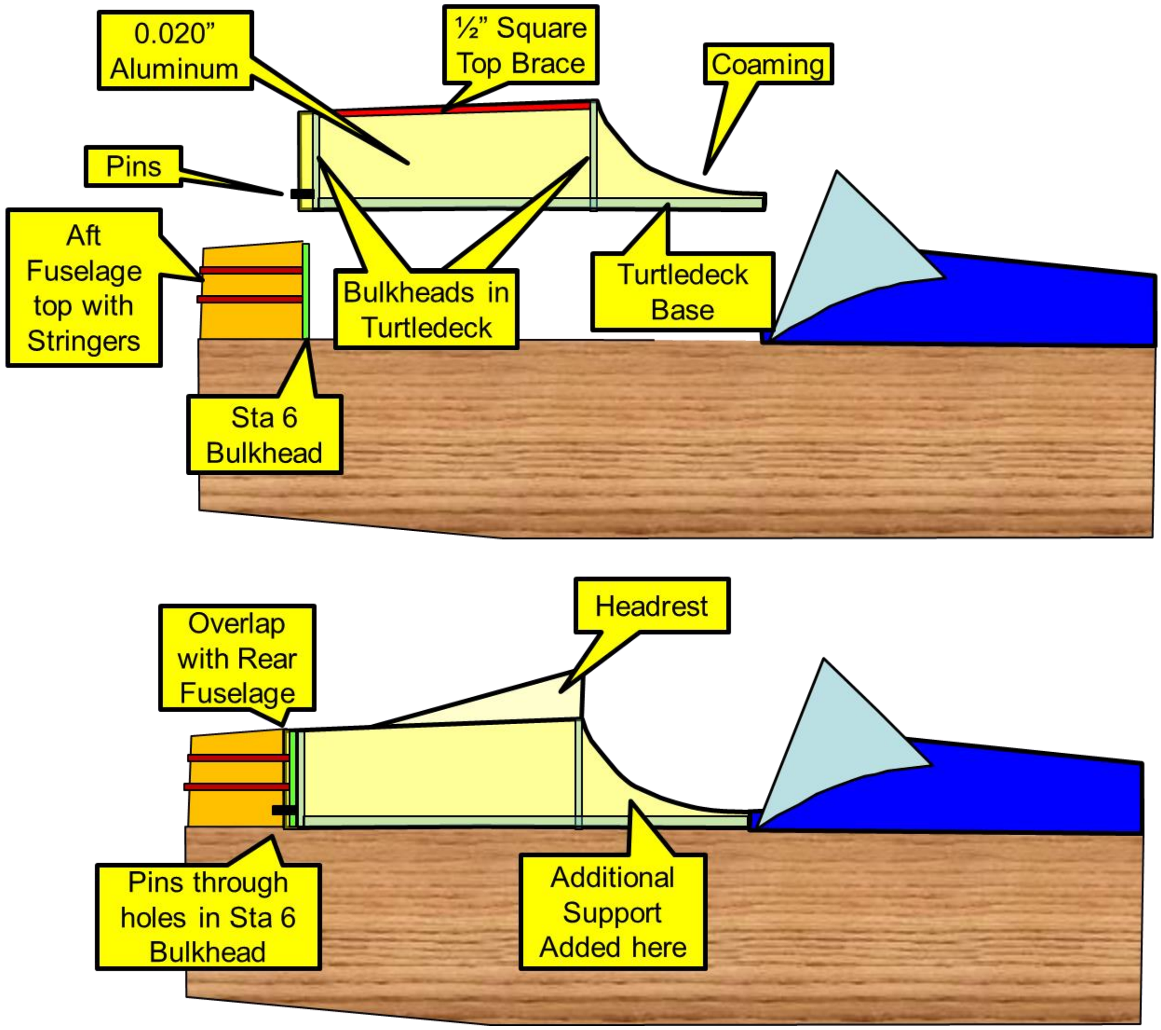

Figure 14: Schematic View of Turtledeck

4.2.3 Construction

4.2.3.1 FRAME

The basic frame for the turtle deck is shown in . The base is six laminated 1/8" strips of wood, laid in place on the top of the fuselage.

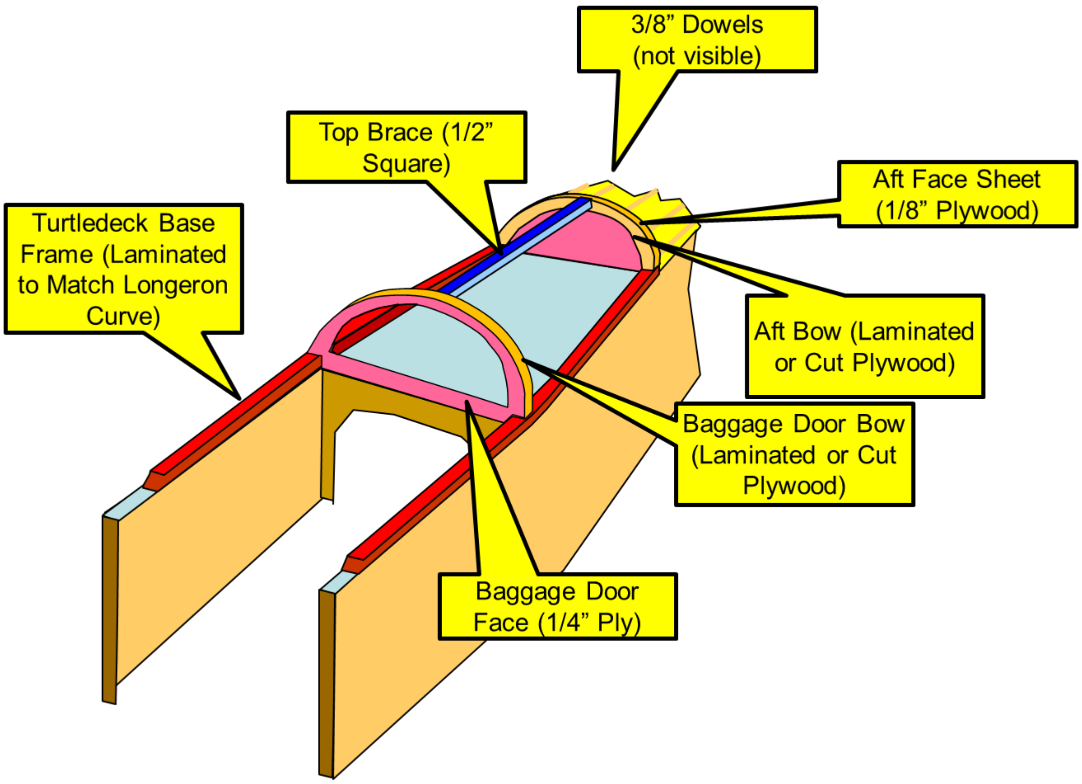

Figure 15: Turtledeck Frame

Construction begins by covering the top longerons of the fuselage with wax paper, and tacking down temporary guide blocks on the outside of the fuselage (Figure 16). This should be "old hat" by now.

However…when I sit and rub my chin, I wonder if this is really necessary. Seems like one could cut a longish piece of 3/4" plywood for the frames as well.

The next step on the frame is to add the two bulkheads, consisting of a sheet of plywood (1/4" in front, 1/8" in back, backed-up by a curved bow. Again, Pete has you laminate the two bows, but I wonder if cutting them from 3/4" plywood would be sufficient.

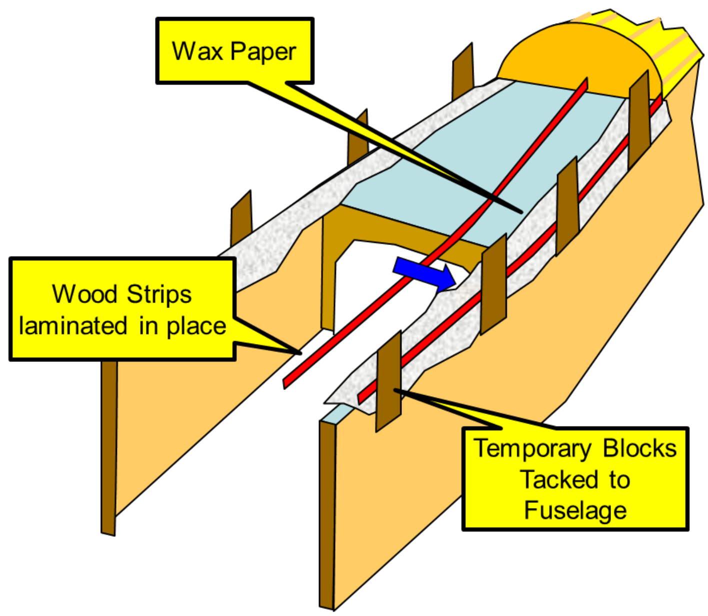

Figure 16: Laminating the Lower Frame

The shapes of the bulkheads differ. The forward bulkhead is a segment of a 12.5" circle, with the chord line about ten inches down (Figure 17). The aft bulkhead is shaped to match the Station 6 bulkhead.

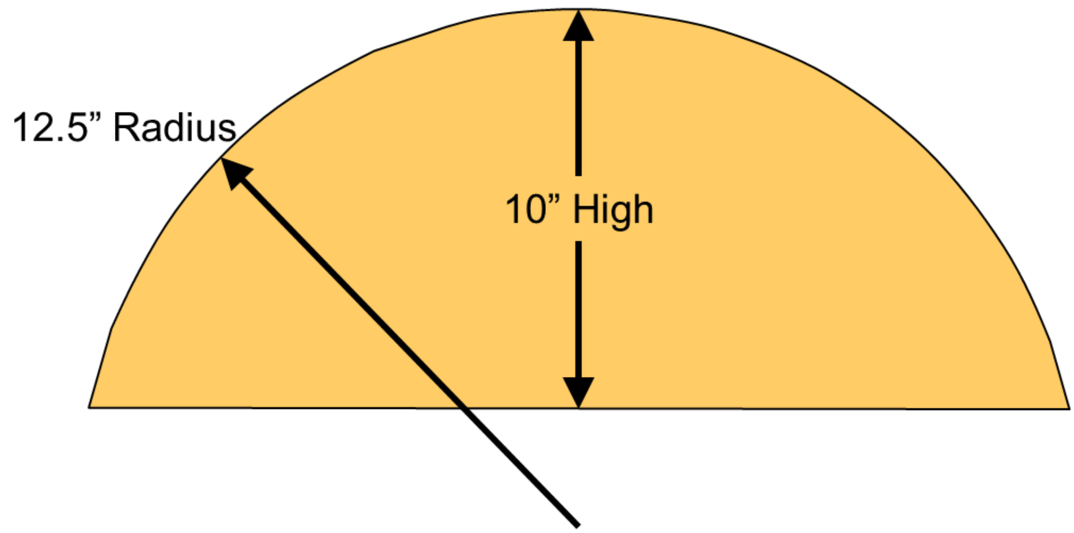

Figure 17: Turtledeck Front Bulkhead

As mention in the "Errata" section, Pete shows a small door on the front bulkhead, but later on recommended a full-width door. He doesn't specify the dimensions of either opening, but remember, there's a 3/4" thick bow just behind the front bulkhead so you'll want to keep the opening about 1" from the edge. I'd give it just a little bit more at the bottom (say 1.25") to give room to attach the hinges. My own door is shown in Figure 18.

Figure 18: Full Size Baggage Door

Glue the bulkheads in place, and add the top brace (1/2" square wood) and the aft corner reinforcements (Figure 19). Note that the aft corner reinforcements are NOT glued to the top of the baggage shelf area…they are glued only to the rear bulkhead and the side frames.

Figure 19: Aft Corner Reinforcement on the Turtledeck

When satisfied with the positioning of the frame, drill through the aft bulkhead into the Station 6 bulkhead for installing the 3/8" pins in the back of the turtledeck.

Figure 20 shows Jim Katz's implementation of this. Jim used metal pins…not an issue. It's not real obvious in the picture, but the end of the pin is beveled a bit to help it enter the hole. If you use wooden dowels, you can put a fairly good point on it.

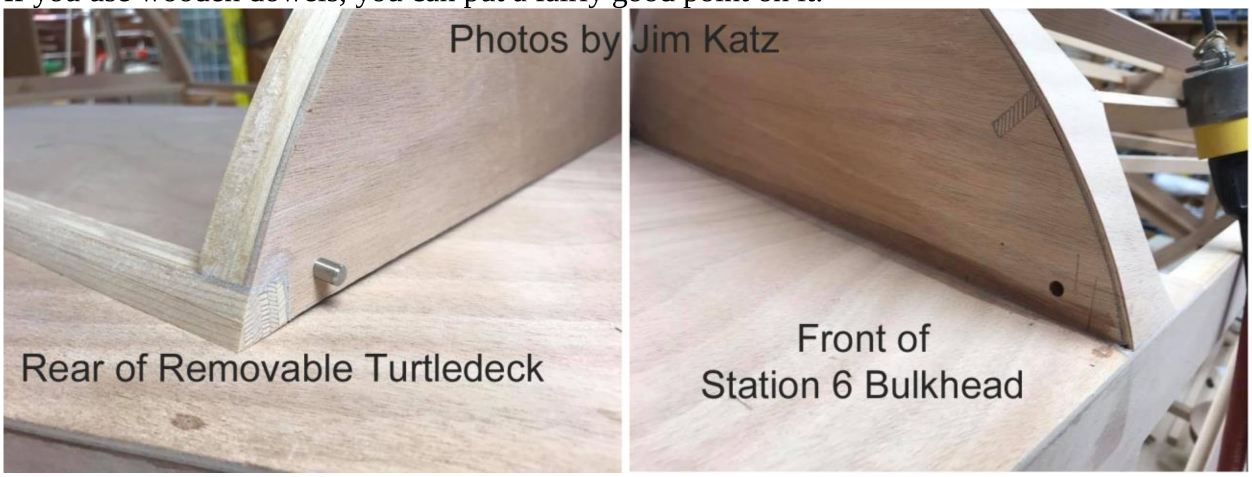

Figure 20: Turtledeck Pins

Figure 21 provides a good view of the frame-building in progress. Notice Jim has gone with the larger baggage door. At this point, the bulkheads have been glued to the frames, so the wax paper is no longer necessary.

Figure 21: Turtledeck Frame in Progress

4.2.4 Covering the Frame

The frame is now covered with aluminum, at least 0.020" or thicker.

It's at this point that the shape of the opening for the pilot, or "coaming" is defined. The top illustration in Figure 22 shows what's generally considered the "stock" shape, while the lower drawing shows an opening with less curvature.

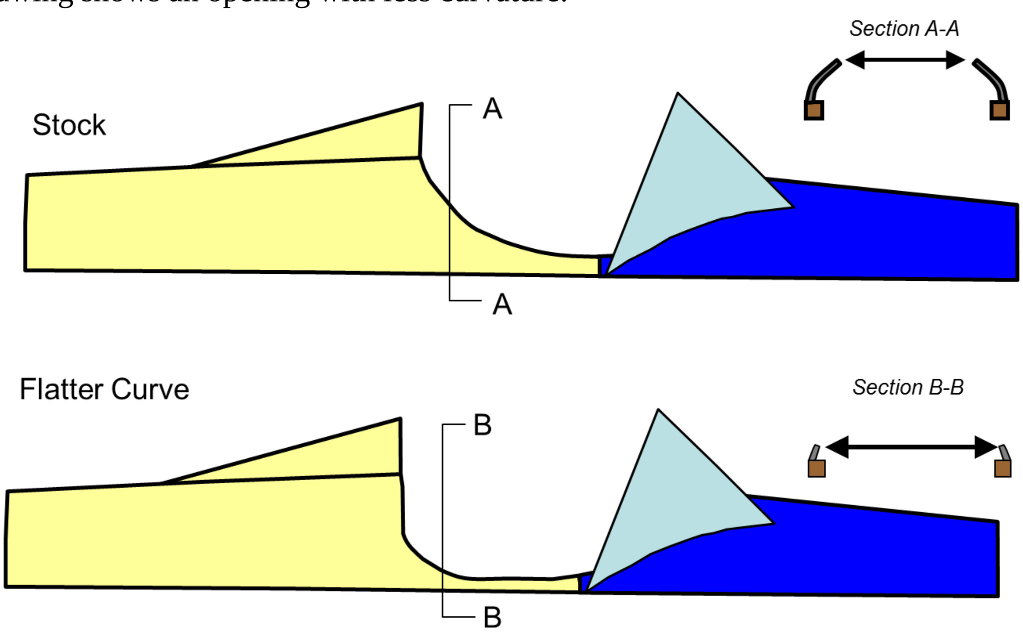

Figure 22: Coaming Shape Options

I tend to agree that the "stock" opening is more attractive…yet, several years ago, I modified my airplane to the "Flatter Curve" option.

Why? Cockpit shoulder room. I have extremely broad shoulders; I'm in the 99th percentile, in fact (e.g., 99% of American males have narrower shoulders). The stock curvature makes the top of the cockpit a bit narrower (see the inset Sections in the drawing above). It wasn't really that much of a problem in the summer, but in the winter, when I was wearing heavier flying coats, it was a bit confining.

It's up to you, really. The main thing is that the forward section of the coaming has to match up with the aluminum on the FRONT turtledeck.

Due to the complex shape of the turtledeck, this aluminum has to be installed as two pieces, left and right. Cut one to the right shape, then duplicate it for the other side. As Figure 6-15 "B" in the article shows, the two pieces butt up against each other along the top brace of the turtledeck. Like "B" depicts, the metal covering should stick out about 3/4" or so beyond the end of the aft bulkhead. This gives a slight overlap at the intersection of the turtledeck and the Statin 6 bulkhead.

Figure 23 shows Jim Katz's coaming, of traditional shape.

Figure 23: Coaming Cut to Fit

4.2.5 Reinforcing the Coaming

Right now, the coaming around the pilot is just thin aluminum. And that ain't gonna work.

Figure 24 shows why. When the pilot climbs into or out of the airplane, he or she braces themselves on the coaming. When getting out, especially, most of the pilot's weight is on their arms, whose hands are gripping the coaming. And that thin aluminum just isn't going to handle it…it'll buckle, first thing.

So that's why Figure 6-15 shows that funny curved thing, in diagram "C". This is reinforcement that must be installed in the area around the pilot, so that the pilot's weight is transmitted to the top longerons, and the aluminum doesn't buckle.

Pete shows dimension on diagram "C", but in reality, this piece is just cut to fit inside the metal of the coaming. It's screwed into the metal, and the lower part is glued to the frame.

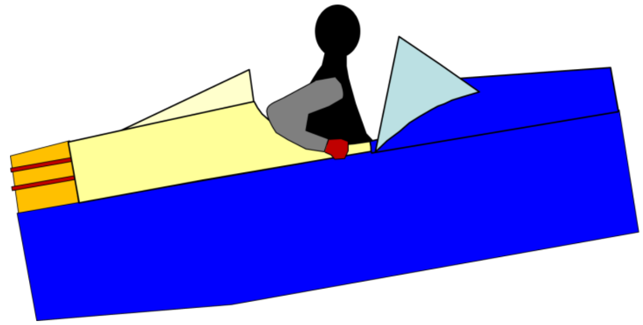

Figure 24: Bracing for Exit

Start as shown in Figure 25. Take a piece of 1/8" plywood, about 12" high by 19" long, and hold it against the inside of the coaming curve. The back edge of the plywood should be flush against the baggage door bulkhead, and the lower edge flat to the lower brace of the turtledeck frame. The plywood should also be flush along the curved edge of the coaming…you'll have to hold it in place, since this is a curve.

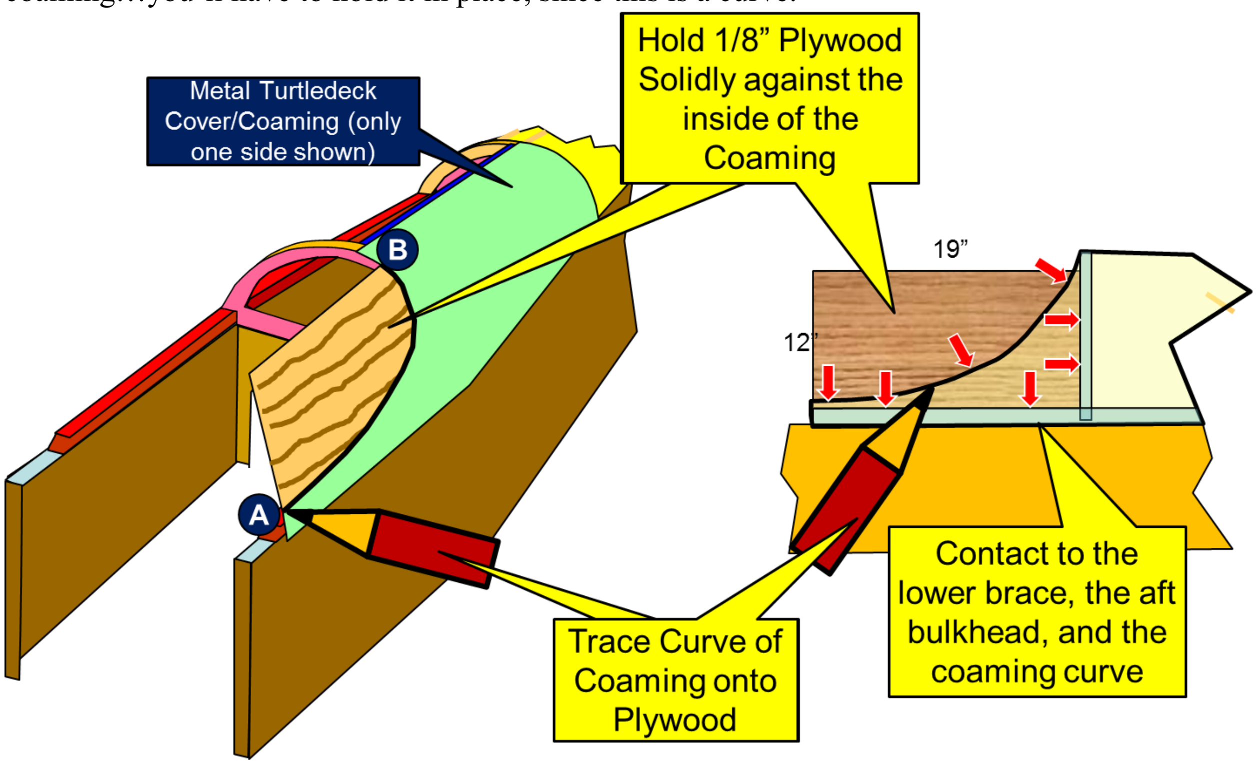

Figure 25: Marking Plywood for Coaming Reinforcement

With the plywood hard against the bottom and back, and the edge of the coaming line, trace the shape of the edge of the coaming onto the plywood. This is the "A-B" line Pete refers to.

Remove the plywood from the frame. Draw a line parallel to the first, about one inch lower down. Add two lines for a vertical support to fit between the reinforcement and the lower turtledeck frame.

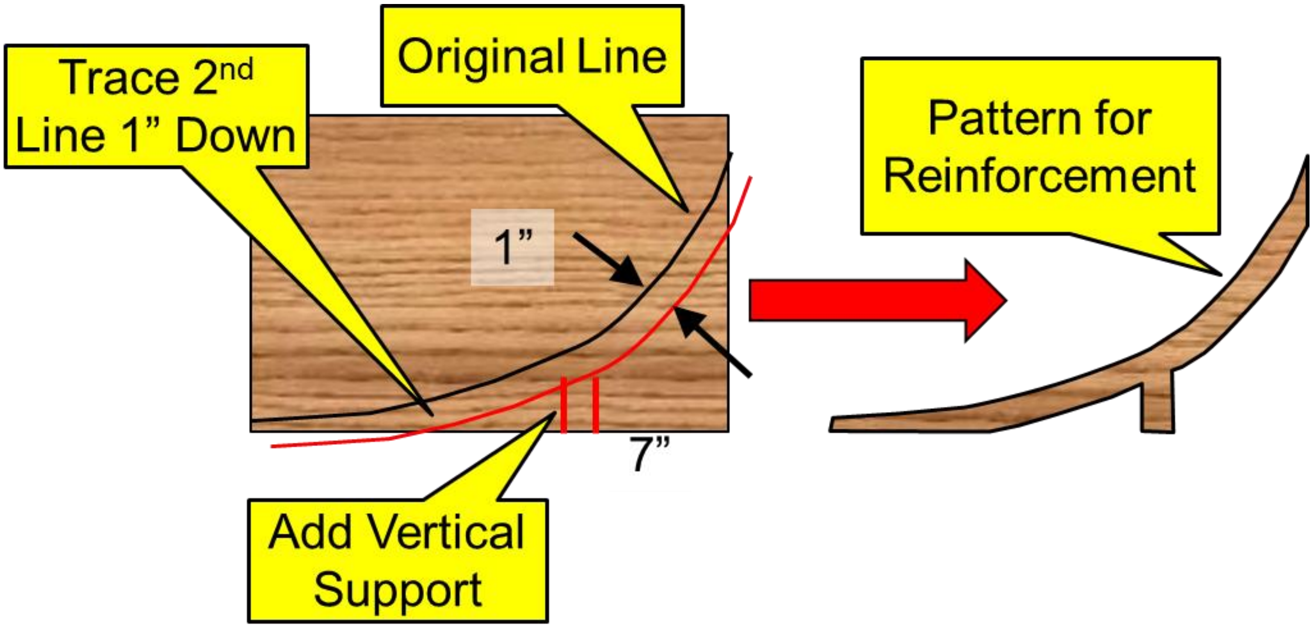

Figure 26: Drawing Reinforcement Shape

Make four copies of the reinforcement, then laminate into place as Figure 27 shows. The pieces of plywood glue to each other, the baggage bulkhead, and the lower frame of the turtledeck. Clamp like crazy so the strips nest inside the metal coaming. Don't worry if they're a bit large and stick out above a bit.

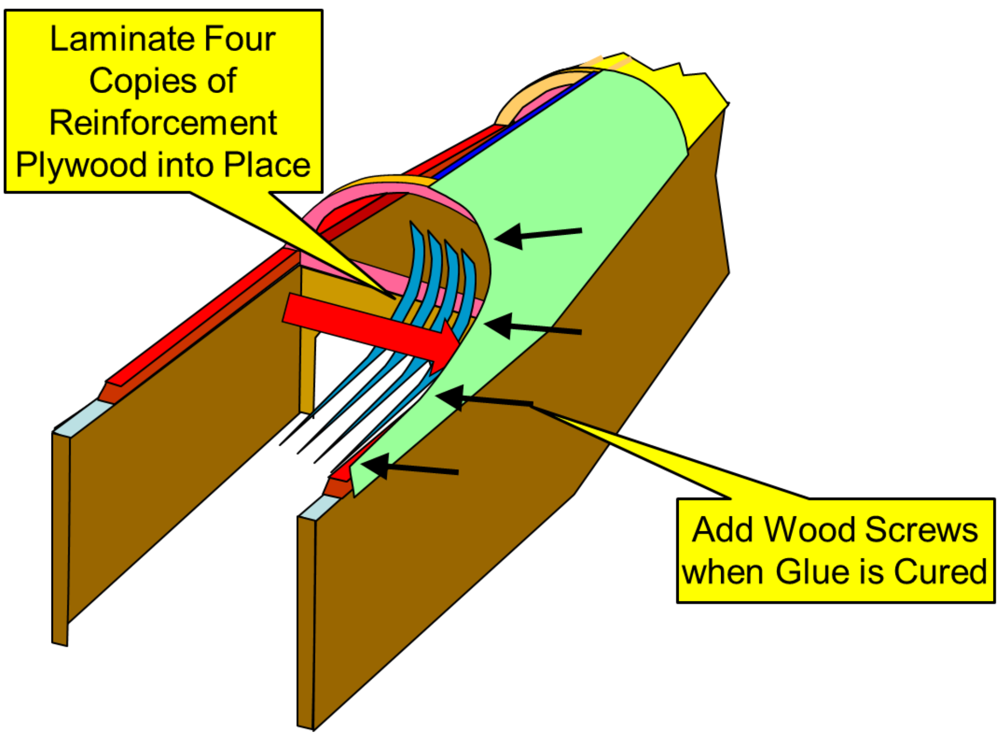

Figure 27: Laminating Reinforcement

Once the glue cures, add a few ~3/4” wood screws through the metal coaming into the lamination to hold it tightly to the metal. Then feel free to shape any excess wood from the laminations that sticks out above the metal edge of the coaming.

Then repeat for the other side.

Figure 28 shows a completed reinforcement. Note how it glues to the edge of the baggage bulkhead, as well as along the top of the turtledeck frame.

Figure 28: Coaming Reinforcement In Place

As I mentioned earlier, I modified my coaming to give a bit more shoulder room, and of course had to modify the reinforcement. But since the coaming metal was just running (mostly) parallel to the frame of the turtledeck, this the reinforcement was just, basically, some strips of wood. They can be seen in Figure 29.

Figure 29: Reinforcement for Ingress/Egress on Modified Coaming

The edge of the coaming needs to be covered, for aesthetics if nothing else (though there's going to be a sharp metal edge there, somewhere. I have a vinyl cover for mine (Figure 30).

Figure 30: Coaming Cover

Note that this cover goes over the front of the headrest as well; many folks just run their cover in two pieces, one on either side. They can be laced into place, or snaps can be added (as can be seen on my cover).

If you're able, add some padding under such covers.

4.3 Headrest

By this point, the headrest should be pretty straightforward. As Detail "D" of Figure 6-15 shows, it's a wooden frame with a kind of crescent-moon plywood shape up front. Usual practice is to glue some foam to the plywood and cover it with vinyl, as seen in Figure 31.

Figure 31: Headrest Pad

However, please note the "Errata" entry in Section 2.3. Figure 6-15 is actually in error, by showing the lower cross-brace of the headrest being straight. This has to be arched to match the top of the turtledeck. It's just a short piece, so it'd probably be easiest to just cut the brace out of 3/4" spruce and carve to fit.

4.4 Cowling

This was actually addressed in the Guide for Article 7, but the same material is duplicated here.

The cowling is basically a stock Cub cowling, with a Cub-type attachment system. It seems like cowling fits in better, here, so let's cover it in this Guide.

We'll be discussing on the stock Cub-type cowling here; if you're building a pressure cowl, see the Tony Bingelis references.

4.4.1 Construction

The Fly Baby cowling is pretty simple: A J-3 Cub "Nose Bowl" at the front, and two sheets of aluminum forming the top and bottom. The two halves the nose bowl are attached to the aluminum sheeting to produce an upper and lower cowling half (Figure 32).

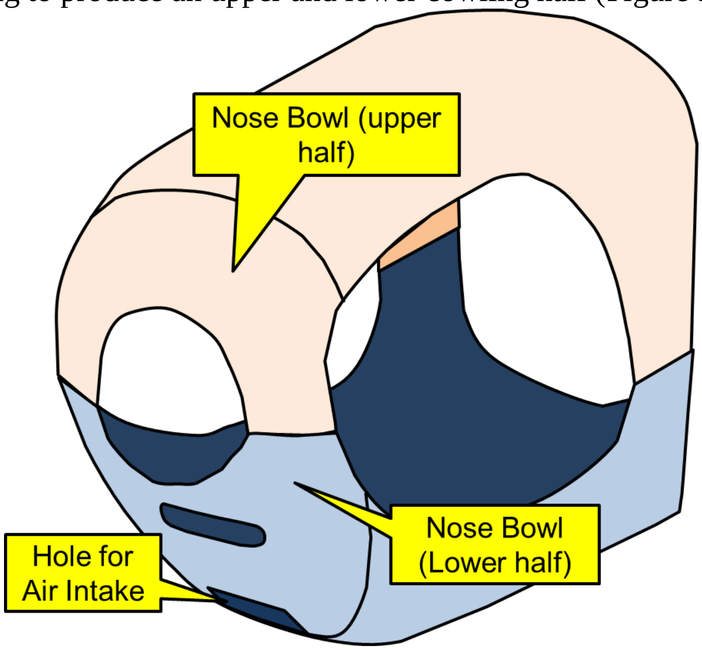

Figure 32: Sample Cowling

The nose bowl can be made from either aluminum or fiberglass. You could try to tackle making one yourself, but the commercial units would be a lot easier. Figure 33 shows the non-PMA[1] unit Wag-Aero sells for $250. They come up occasionally in the used market, too.

The nose bowl is split into an upper and lower unit. The two sides are attached to the upper and lower aluminum, typically by rivets.

Commercial companies like Wag-Aero, Aircraft Spruce and Specialty, and Univair sell full cowlings, too. However, these are generally PMA'd parts and are priced accordingly. Also, depending on your own engine installation, some of the mounting holes on the firewall end might not be right.

Figure 33: Wag-Aero J-3 Nose Bowl

In Article 10, Pete specifies 0.025" aluminum for the sheet part of the cowling. The top part of the cowling is pretty

[1] "PMA" stands for "Parts Manufacturing Authority." Companies selling parts for certified airplanes must receive authority to do so from the FAA. Since the Fly Baby is not a certified airplane, a non-PMA'd part is perfectly OK.

easy, since it just wraps around the curved forward turtledeck. The bottom cowl is more complex, since it meets the rectangular lower fuselage.

Obviously, you'd probably want to build a mockup first, using cardboard or similar material, to get the shape right before cutting the metal.

4.4.2 Overlap

The upper and lower cowlings do not just butt up against each other. They overlap by an inch or so. The fittings that attach the cowling to the airframe (pins, screws, etc.) should be installed through these overlap areas to hold both units. Figure 34 shows the overlap areas between top and bottom. The top cowling always goes on top of the joined areas; this allows you to just remove the top cowling when working on the engine.

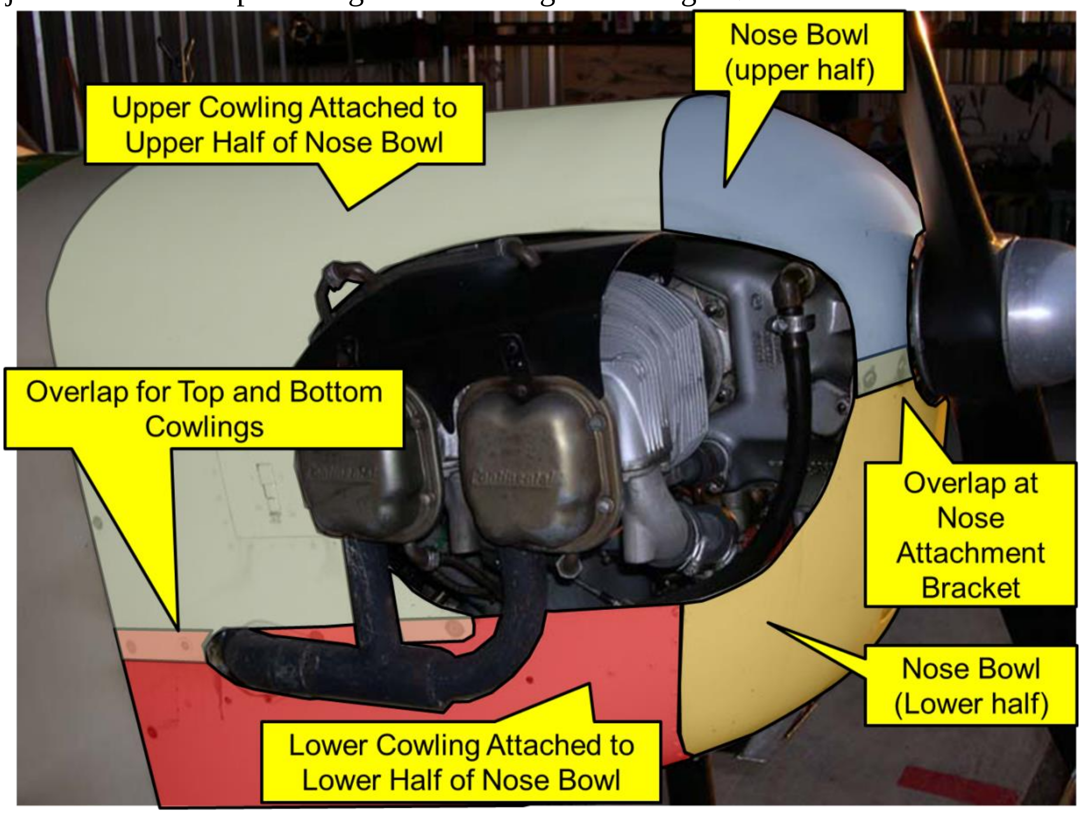

Figure 34: Overlap of Cowling Pieces

4.4.3 The Holes in the Cowling

The nose bowl will include one of the significant "holes" needed, such as a gap for the air intake (visible at the bottom of Figure 33). Depending on your particular setup, you may have to alter these holes a bit.

You might need additional holes for the exhaust, if you're using a Cub-type system. The exhaust tubing must enter the cowling to go into the muffler behind the engine. If you look at Pete's illustration 6-16, you'll see a circular hole behind the cylinder hole. This is for the exhaust pipe. Figure 35 shows the implementation on my own cowling…note the hole is kind of oval since my exhaust pipe curves in a bit. Note that the position of the exhaust pipe pretty much sets where the "split" between the upper and lower half of the cowlings goes.

Figure 35: Hole in Cowling for Exhaust Pipe

If you're using a stub or Aeronca exhaust, this additional hole won't be necessary.

The final set of holes is the big ol' ones: The ones for the cylinders.

In my opinion, there should be a good bit of room, here. The builder of my Fly Baby made the cylinder holes (Figure 35 above) a bit too tight. It looks good, but the ignition cables run a bit too close to the edge of the cowling. The section of the top cowling that curves forward under the cylinders is a bit of a pain, too. I have to carefully hook it around the cylinders whenever taking the cowling off.

To me, the right side is worse. The hole follows the cowling so closely that a separate door for accessing the oil cap is needed. How much time do you think it took to make that door? If you look at the pictures of the right side of J-3 Cubs, you'll see the cylinder opening on the right side is large enough that the oil cap can be accessed directly.

Figure 36 compares my cowling (with the oil-check door) with that of N500F, the original prototype Fly Baby. The right side opening on N500F is enlarged to the extent that the circular hole for the exhaust pipe isn't even needed. This size of hole also allows a better ability to inspect the engine during pre-flight, and even to do some minor maintenance without removing the cowling.

Figure 36: Cowling Comparison

It's up to you, of course. But I'd at least make the right-side hole big enough so you don't need a separate door for checking the oil.

4.4.4 Cowling Attachment

Figure 36 shows two different approaches for attaching cowlings. N500F uses the same method as the J-3 Cub, as described in Article 10. Two L-shaped brackets with ~1/4" pins are attached to the lower part of the firewall. The cowling portions have matching holes. A bracket is attached to the front of the engine, with two similar pins. Safety pins are slipped into cross-holes in the ends of the pins. That's a total of six pins that have to be pulled to remove the cowling.

On the right side…well, my cowling requires me to remove 15 screws and undo six dzus fasteners. It takes a bit more time, of course. Sure, it's sturdy, but the cowling on N500F has ~1500 hours on it with no problems.

Where things get a little tricky is the attachment at the front of the engine. Brackets of some sort usually attach the front of the cowling to the engine. C-series engines and the O-200 have provisions for tapped holes around the exit point for the propeller shaft. A steel bracket can be bolted here with appropriate connections.

A-series engines (normally) don't have these holes. Cubs attach a pair of triangular brackets to the through-bolts in the engine case.

These options are shown in Figure 37; a picture of the triangular brackets is inset at the lower right. This picture is of my own C85, and the bracket using the tapped holes is visible. One caution: When installing things this close to the propeller, make sure they're solidly secure! Safety wire as needed.

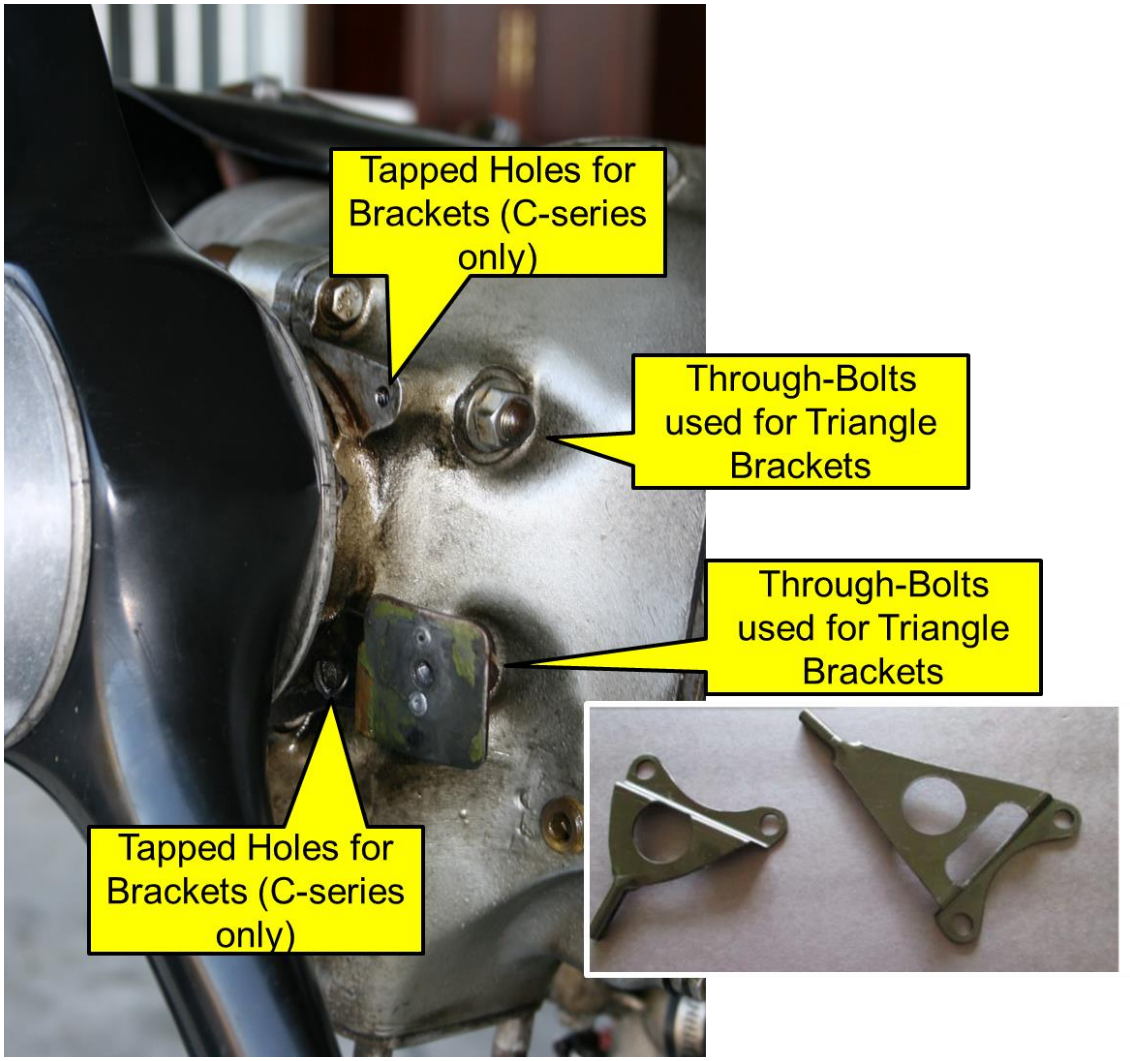

Figure 37: Cowling Front Attachment Options

The final option is to NOT include a front cowling attachment. Figure 38 shows Ross Bowden's cowling. The top and bottom cowling halves attach to each other in front, but there is no bracket holding the joined section to the engine. Instead, Ross added many attachment screws at the firewall.

Note that this is the same approach used by some production airplanes, so this isn't that unusual. It has the advantage of isolating the cowling from engine vibration. It has the drawback of having to extract ~25 screws from the cowling to remove it.

Figure 38: Cowling Without Forward Attachment

4.4.5 References to Tony Bingelis Articles

See Section *Error! Reference source not found.:*

February 1974 Page 51: "Cowling Installation"
May 1986 Page 23, "Cowling Installation"
October 1996, "Cowling Installation Notes"
October 1973 page 14: "Engine Baffles for C85 and O-200 Continentals"

4.5 Wing Wire Anchors (Stock Bracing System)

Way back in Article 1, we discussed the Fly Baby's wing-wire attachment system, and presented alternatives.

Article #10 has you fabricate the mounting plates for the STOCK wing-wire anchors. These are bolted through the wing wire mounting pads that were installed during wing construction. Figure 39 shows this arrangement,

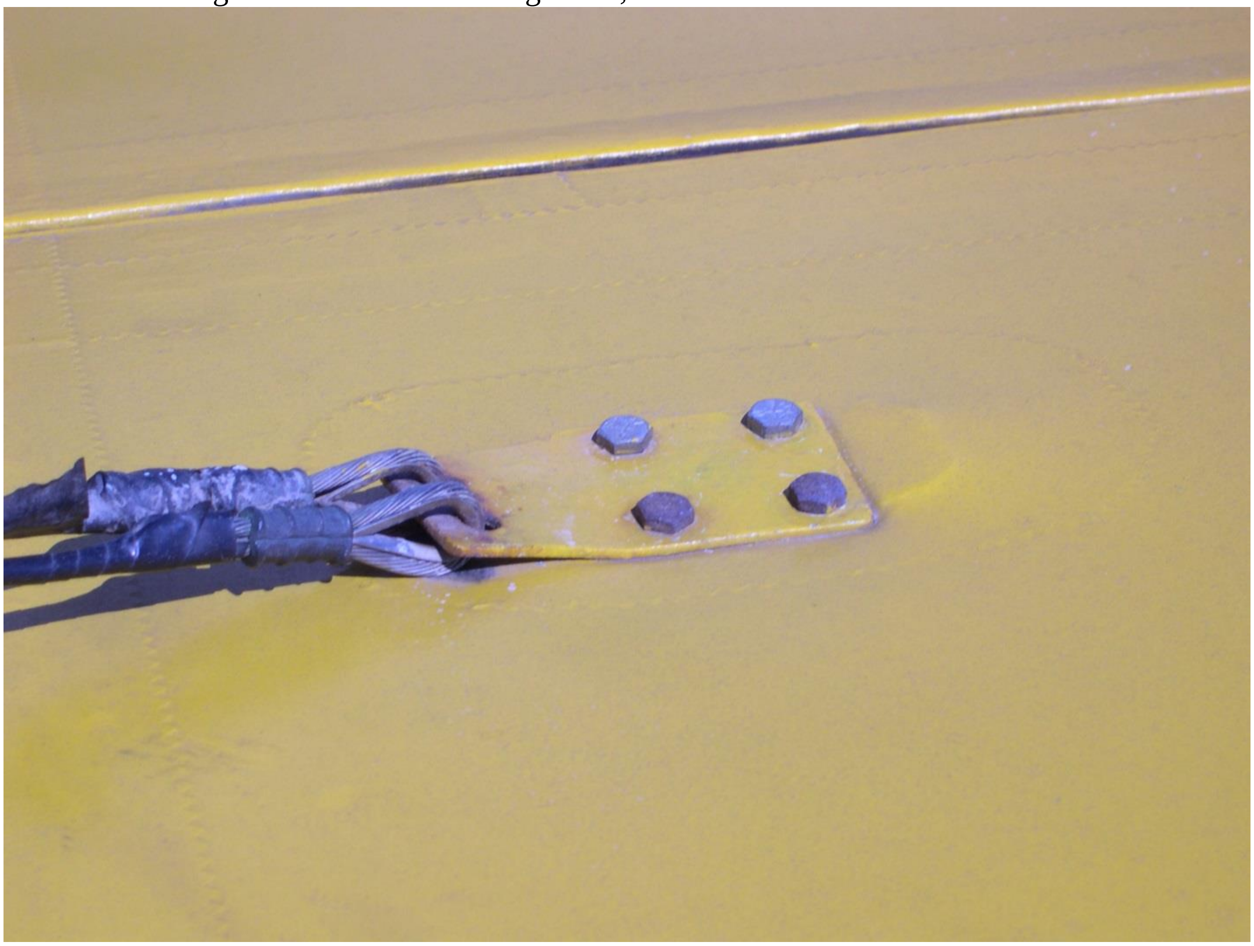

Figure 39: Stock Wing Anchor (aft)

If you used the stock system, build the plates as shown in Figure 8-2 on page 22 of Article 10. As noted in the "Errata" section, you might have to make the plates a bit longer if you're using larger bracing wires/turnbuckles, or plan on a different assembly sequence.