

MAKING BOX FUSELAGE FRAMES (STRAIGHT)

By Michael Heinrich

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(Cloudbuster Ed Note: I have been asked how to build straight fuselage sides, but rather than explain my way, let me say, this article is very similar to what I do. The article was saved from the old smallflyingarts forum. If you have no trouble building fuselages without bananas, don't read it, but if you want some good tips, read and enjoy)

Here's a procedure for making box frames that Tony Peters showed me when I was just starting out in this hobby. I think it's the easiest and most accurate way I know, and requires no fancy tooling at all. As with any technique in this tradition, I've added a bit here and there, and I also will bring in comments and tips from friends who've added to the craft.

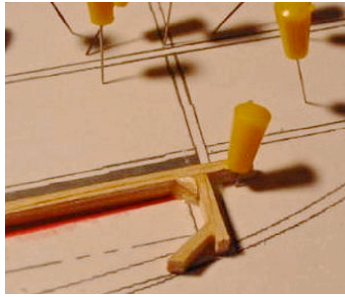
For anyone doing this for the first time, the best basic text for learning this stuff is a series Bill Warner did in Model Builder magazine, titled "Hey Kid!- Ya wanna Build a Model Airplane??" This series started with the basics of flight and learning how to "see" what a model is doing and how to deal with it, and works you through progressively more complex models and construction procedures that get you ready for anything you might want to try from there. It's a great source. Dennis Norman sells a ring bound reprint, by permission, of the entire series. Email him for details.

LARRY MARSHALL: "So many modelers believe that a # 11 blade can substitute for any other cutting device. As you've indicated, when building with sticks, you NEED single-edged blades, which don't crush the stick ends and can facilitate obtaining square cuts. They are NOT optional or some affectation of us old guys building model airplanes." To expand on Larry's comment: a nice # 11 blade looks sharp, pointy, and efficient, but you need a long flat surface to sight down when cutting square. Save your # 11 for slicing curves in sheet, and even then, leave stock for sanding. (Editor'S Note: I like using a double edge razor blade, broken in half, then chunked in my exacto knife. I can tell when it is angled just right, before slicing.) (PFFT Ed. Comment: The very best single-edge razor blades are "Extra Keen Single-edge Blades" by American Line. Campbell used to carry them and I believe Ace Hardware carries them. They are much thinner and sharper than "hardware store" blades.)

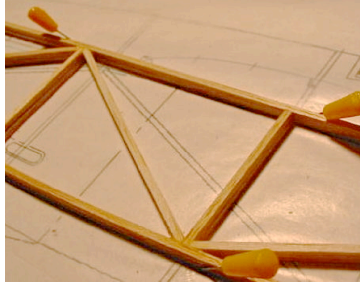


The second thing I want to mention: I'm doing both left and right sides of the box here at one time, with no Saran wrap, no worry about gluing together, no nothing. Why? Because it's half the time that way, and more importantly, it's lots more accurate. I start by pinning the pair of top longerons to the line with side-by-side pins holding the longerons snugly. Then, I'll cut pairs of uprights, a little long, and glue them wherever they go. I'll put the bottom longeron in later, and you'll see why then. All the bits of wood that go against the top longeron — the uprights, any gussets like you see here at the sternpost, the scarfed piece that will form the stabilizer slot—all are glued in now, while I have room to work. I put a pin at the bottom of the too-long uprights, pushing them against the longeron for the glue to dry. This takes maybe fifteen minutes in aliphatic glue, less with Duco; so you'll go from one end of the fuselage to the other in that time, then go back and remove the pins for the next step.

But not yet, there's one more thing I want you to look at here. I'm holding sticks taped together to make sure the wood I want is all matched up. Store-bought sawn strips are never quite perfect in dimension, and they're all different stiffness and weight. I use a gram scale to grade all the strips I have, then decide if the lightest ones will be stiff enough by bending them in both directions, selecting the stiffest (You'll notice those with straight, long grain are stiffer than ones where you see diagonal grain running through the stick on one side). Now, those stiff long ones are paired up for longerons, and the less-stiff ones can be used for the short bits (within limits: no punky wood, anywhere. You decide.). The taped-together part is so I can work with TWO bits of upright at a time, without having to fumble with them.



Here's the sternpost after the pins are removed. Everything hangs down well past the inner edge of the bottom longeron, and you see the little gusset bits glued to the upright, also long: so that when I trim the bottom line, that joint will be perfect and I won't have to fiddle with tiny angle bits, which sometimes can be a tricky angle indeed.



Now here's the bottom longeron in place. See where the diagonal braces (which can be even lighter wood, as they're all compression, and anything that will break them is more than the model will like anyway!) have been fit a little long, and they have been trimmed too when the cut was made; now they form part of the glue joint as well. The corners against the top longeron and uprights were beveled too, but I had room to work then, remember?

Joints are critical. The closer we get our sticks to fit, the better the airframe will be. Filling glue between balsa does not give a great joint. It's one reason I like cutting and trimming the sticks I use in the ways I do, it gets me joints that line up & fit in a pretty easy way. Also, I can spread out the joint over a longer area, when I cut my diagonals and uprights in one pass like you've seen here; if I had to make that four bevel cut on each diagonal and get the lengths right before dropping it in, I'd go crazy.

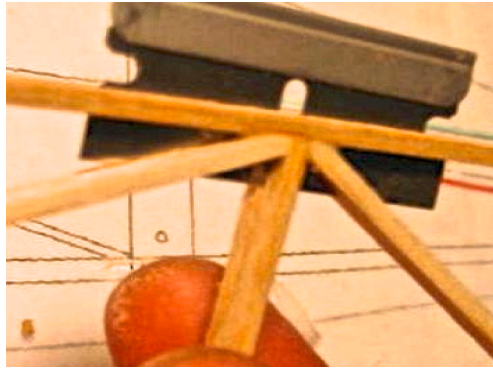
The best thing to me about doing things this way is that I can't cut anything too short, ever. There's no fiddling around trying to fit exactly between top & bottom longerons, or do any of the other fiddly bits need anything fancy at all.

With a frame like I'm making here, there's not so much stress to gentle curve of the bottom longeron, and the diagonal braces will keep the curvy part from moving when it's freed up. But you do want to consider those stresses, and in your own box frames you may add a brace or two in areas you might be worried about. Don't be afraid to depart from the draftsman's drawing, that's how you come to find your own way of doing things.

With stressed structures, a lot of us will give the frame a soak of water (usually mixed with ammonia, or Windex, to cut down the surface tension of the water and get it to seep in better), to relax the wood a little. Ammonia will loosen white-glue or aliphatic joints, while Windex doesn't so quickly. Acetate- nitrate glues like Duco or Ambroid won't be affected.

Suggested by ART HOLTZMAN: "Many frames have pronounced curves at the chin, like from the nose block to the landing gear. When I encounter these, I carefully slice the longeron in half (1/16 sq into two 1/32x 1/16) from the LG forward, wet-form the curve on a mold, and run some glue down the split to bond it together again. Once dry, lay it on the plan and keep on building." I'll let this dry overnight then I'll take out the pins and sand the top of the double frame while it's still sticking to the wax paper, just a gentle sanding to bring down any high spots.

Speaking of wax paper, another neat trick comes from DAVE MITCHELL: tack everything to your board using Artists' Spray Mount repositionable adhesive, available in rattlecans at art and craft outlets. Put the plan down to the board with it, stick wax paper over that, and you'll have a smooth flat surface that doesn't bunch or wrinkle under your work. Better yet, this sanding procedure can be done with incredible ease when all's tacked down and the frame is hanging to the wax paper.



Now to the cutting apart. The only places the box sides stick together are at the glued joints. You can slip a razor between the sticks at any other place, and push toward the joined spot and it'll cut/crack loose. Takes about five minutes to do the whole thing. A very important thing first, when you are ready to separate the sides, mark an "X" on the front or back of the whole frame to remind yourself which are the OUT-sides. You'll need this little nicety just once, but it's a big once.

You MUST control your blade-if your hands are not in contact with each other, your big arm muscles will push the blade right through the frame. Keep the frame in one hand and the blade in the other, and press two fingers together as a reststop. This allows fine motions with great force. Once in thirty slices, you'll go a little crooked and start cutting an upright. Back off and get back in line, and glue the upright when all's loose.

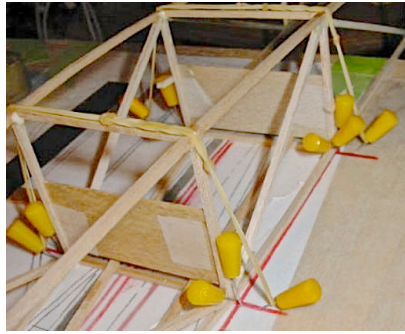
Any sideways slice will ease the force of the cut. Prove this by pushing a sharp knife straight down on a tomato. Look at how deep you can go with a single-edge blade; you can cut most everything you build apart from the outer edges of the frame. Cabin models with elaborate window glazing may be deeper, but the sticks usually flex enough that you can start to bury the backside reinforcement on the blade between the sticks and get down there. Sure, you could break out the blade from its backing, glue it to a handle or not, use a different blade (typically thicker, not a good thing), but I'm preaching the simplicity of using these blades, unadorned, for a very good reason: you don't want to become too fond of them. If you spend time making up something special, you don't want to go through re-making, so you try to stretch more much work out of something that is going to get dull. Sharper would be better. When a blade even hints at getting hard to push, throw it out and unwrap a new one!

Now we start to frame out in three dimensions. I'll talk a little about building straight boxes. We worry over how to guard against "banana" boxes; those frames that seem to fishtail off to the left or right when seen from above. Well, work carefully. -Great, thanks, Michael ... but that's really all, and still there'll be that time when the frame goes off. Like everything you do with such a vague material as balsa, stuff happens. Learn to enjoy it. My best advice, build over a centerline and work one station at a time. Use as many blocks,jacks, squares, what-have-you as you need, it'll work out. There are a few specific things you can do as you build, though, and now we'll look at some.

First, and I didn't talk much about this earlier, try to pick your longeron sticks to be about the same stiffness. I weighed my lumber and picked a dozen nice ones, and I did mention examining them for straight grain (which helps in the stiffness part), but also you can actually try to match for stiffness in the two directions, either trying to gage this by bending in your fingers or by making up a bending fixture with weights and a protractor. I won't go into it here, as I think it's too much to think about right now, but some dedicated guys will go that route.

Larry Marshall's take on this: "Personally, I would never build with pre-cut sticks as I'm too dam lazy to start sticking them on flex meters and such. But as I create them with a wood stripper, I will create pairs of sticks, cut right next to one another off a sheet and these serve as my longerons. This ensures the same amount of flex that you describe."

Now, start to box up. I will do two stations at the first glue-up and no more (if I'm smart, and I'm not always smart), and get the resultant box right and solidly dry before continuing. What you see here is all I did for one evening, and then I let it set up thoroughly. Continuing down the frame from here, you'll have the advantage of an already-dry, solid, integral structure you can count on.



So let's see what's in this picture. These two stations are the only square ones in this trapezoidal-box frame, so they're good as starters. When I cut the cross sticks for the stations I also cut squaring pieces of scrap sheet, a neat trick I got from ART HOLTZMAN—these get taped in and hold the box nice and perpendicular. The great thing is you can cut them for the trapezoid sections in just the same way.

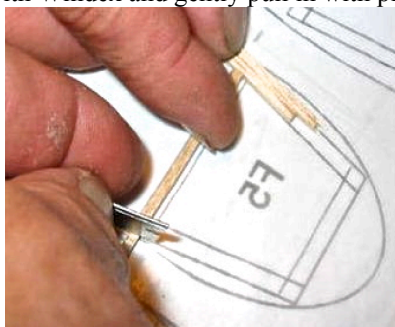
As this is the first pin-down and because part of this particular box bends out of the straight line, I hung the frame off the end of my board. After this I will glue up all the rest over a reference centerline, carefully measuring everything I do to make sure I'm not bananaing the box—but for now, all I needed was a square drawn on the board to line everything up for this glue-up; that's the red lines you see here. One side, the near one, gets pinned down along the reference line, the bottom cross sticks glued up and placed in their positions, the opposite side brought up and pinned down. Then the squaring pieces are put in with lo-tack tape, top cross sticks glued in, and as a precaution I spread rubber bands over the whole thing. (Those are little dental bands, looped together with a lark's head knot, to make up the length I want. Handy and quick.) I'm building with aliphatic glue, which has a little more working time than Duco, but that's doable too; and you could set up the whole frame you see here and run drops of CyA to assemble, too, if you do that sort of thing. (Editor's note, do not rely on your uprights alone to align both sides here, look at the aft end. Make sure they are the same length, they were when you built them, make sure they line up now. You might even want to pinch the tail together and see if it is even when on the centerline.)

Once dry I'll pull this off the board and glue up fore&aft of this.

One more banana-busting tip, and you'll see it in this next sequence: do the low-stress end of the box first: usually heading toward the tail. Then tackle the hard end.

DICK FORS: "When assembling both sides of a box frame, as in the process of building a square section, once I'm certain a section is square, I like to glue in a temporary diagonal brace. Sometimes, several of them in different sections as I go along. Adds lots of strength until the frame is complete!"

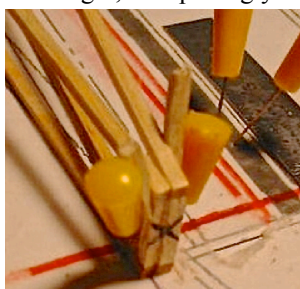
Earlier, I told about stress-relieving with Windex, but there's something more important to try to do: don't have any stresses in the individual bits of wood that make up the frame! This is a guitar maker's trick, and they have good reason to have no tension in their structures—here, it just means we have less ready to break off at the wrong moment. I will pre-roll a curve into a stick that bends, just laying it on the board and pulling it under one pressing finger until it takes the shape of the curve I need. Harder bends, I'll soak and pin up overnight, or soak and then pop in a 250-degree oven for an hour. I didn't need that for this frame, but keep the technique in mind. It's harder to prebend the sides to curve into the nose of the box. Bending a whole side frame—nope, better to soak with Windex and gently pull in with pins, squares and rubber bands.



Not all box frames are square-section. You'll often need to make trapezoidal boxes, both when unadorned as in a boxy-shape model or with formers hung over the box—which is where this method really comes into its own as you can bend the box around to fill out the most space with the least wood. This will be shown in detail in the next installment of this tutorial. In the picture below, you see my cheep and dirty method of cutting cross sticks for trapezoid sections. Ignore the lines on my drawing here. I blew it up, and the wood sizes as shown are now way over what I'm using, so I can't just go slicing my crosspieces off the section views. So, to get the right size, I'm holding two sticks of my model's size in my right hand lined

up with the outside edge of the section; I'm pushing the crosspiece against the inside edge of those sticks, and cutting the piece along the outside line on the other side of the section. See? [Section] minus [two sticks] equals [space between sticks on each side]. Jeez, I hope that's clear.

Now comes the gluing of the sections. I've drawn a centerline on my board, willy-nilly and in no place, just to line the frame up with. The box frame is laying curved-side down and I've pinned the last square section down, centered, there out of the picture. You can just see a little black hatch mark on the crosspieces, right in the middle of their length-they tell me which side is up as well as where they should go on the board centerline. I glue the bottom one and pin the sides against it, then pry open the top and glue the top crosspiece in, and run my rubber bands over the whole section for tension. I'm holding my scale on end as a quick square-check, and If the mark on the crosspiece is out any amount, I can pull the pin with the rubber band out on that side and pull the section back into place that way. It's a very easy and, once you get used to the risk and just trust yourself to do it right, a surprisingly accurate way to get things lined up.



Here's the end of the frame. Two things I want you to see here: first, I pinned and closed the tail post with pinpoints on the bottom, but the top edge still spread open. So I sliced a bit of extra stick at a long angle and used the two pieces as wedges. Cheep & dirty, again. Also, notice my two sides are about 1/64" mismatched; after all I did to keep things lined up perfectly. The frame is square and un-banana'd though, and after a pass of my sanding block, you and the air will never know the difference. So don't worry the little stuff!!

There're the basics. After this, you can hang any bit of wood you need for attachment hard points, anything you didn't put in your original box-side, what have you; and we can go on to fit formers, for a rounded model airframe.