

Scratchbuilding

(or why don't they make a kit?)

By Mike Belcher

- Retired Mechanical Engineer
- Modelling since 1975; First kit was a scratchbuilt 1/35 tank
- Resin casting since 1994; scratchbuild my own masters
- Have done armour, aircraft, helicopters, sci-fi and missiles
- Love building, hate painting



Scratchbuilding: What is it?

Making a model for which there is no kit

Scratchbuilding: Why do it?

- Not available as a kit
- Not available in desired scale
- Existing kits are really, really awful
- Desire to have something unique
- Wish to be creative

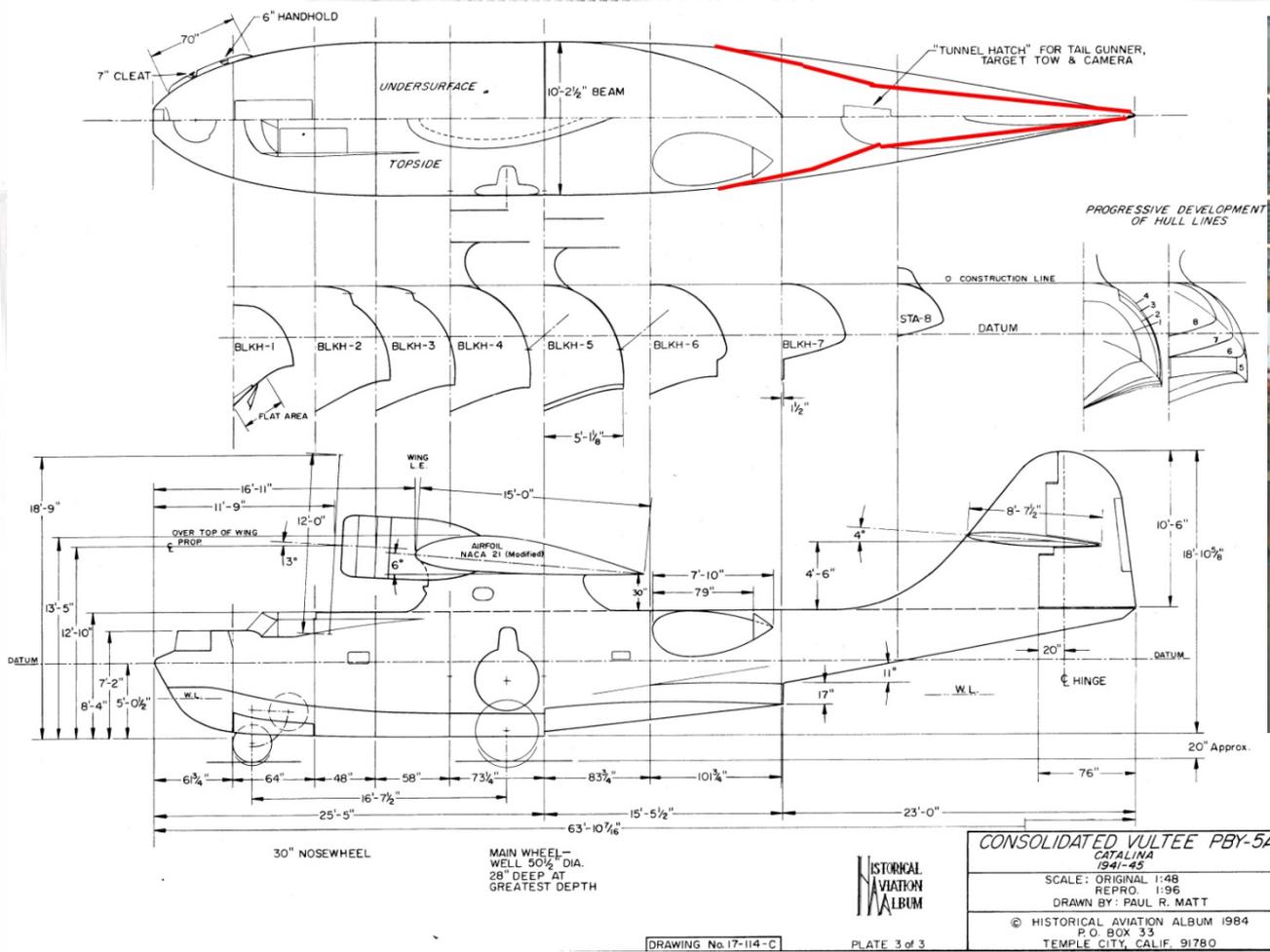


Scratchbuilding: How to do it?

- Start with a good drawing
- Sorry, some math is involved
- Get as much info on the subject as you can
- Have a few basic tools on hand
- Learn to love plastic in all its forms
- Start cutting, gluing and sanding

Start with a good drawing

- Not all plans are accurate; Even apparently well drawn ones may contain errors



Start with a good drawing

- Some plans were accurate when first drawn. However, they have been printed and re-printed and no longer match the stated scale.
- Always check the drawing using dimensions.
- Many drawings give a scale bar, but this is usually quite small. Better to check against a large dimension as possible.
- Some drawings give 'Station Diagrams'. These are datum points for manufacture and are useful for accurate dimensions. However, note that in many cases, Station 0 (where all dimensions are measured from) may not be at the very front of the subject. It may even be well in front of the subject.
- Typically, Station Diagrams are in inches on North American subjects, but may be in millimetres for European subjects.



**Belcher
Bits**



...or make a good drawing

- Sometimes plans are just not available
- Be careful using photos; try to get shots from the side or top
- Even with straight side shots, there will be parallax distortion
- You can overlap photos to try to get rid of this



Martin YB-61

All were expended as targets

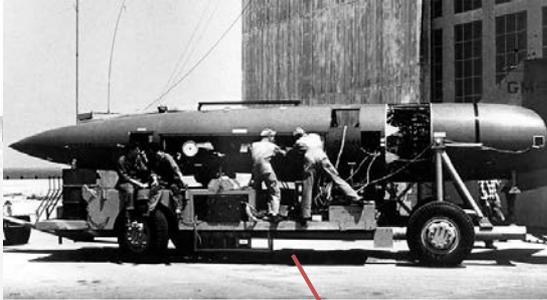
None exist today



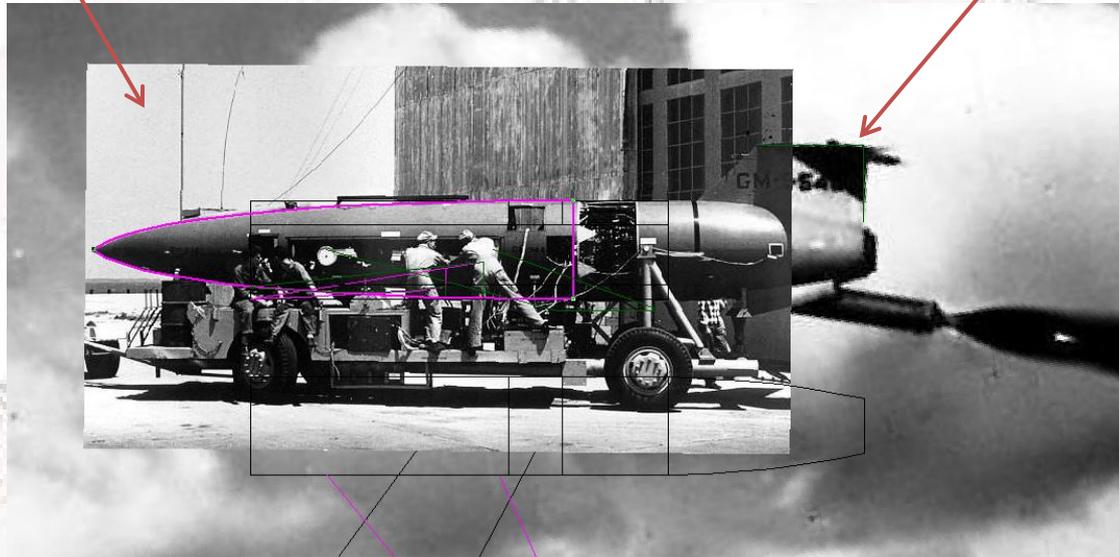
Crazy me ... I wanted a model

...or make a good drawing

Here I imported two side shots, scaled them and overlapped them...



...then traced my drawing on top



Sorry, some math is involved

- Scale: What does it mean? It is a FRACTION.
- You want a $1/35$ scale model of a subject. That means it is $1/35$ the size of the original. If the full size object is 18 feet long, your model will $18/35 = 0.51$ feet long. How long is that? Who knows! Better to work in inches (or mm).
- Your 18 foot original is $(18 \times 12) = 216$ inches long. Your $1/35$ model will then be $216/35 = 6.17$ " long.
- Say you have a $1/72$ drawing and you want to enlarge it to $1/48$. Take the length, for example and measure it. Multiply that length by the original scale (72) to obtain the full size length. Then divide by the desired scale (48) to get the model length. This works for any scale.
- The key thing to take away from this is you NEED a calculator, and you NEED a ruler marked off in decimal (10 divisions to the inch) graduations. That way, when you need to mark 6.17 inches, you can do so without having to memorize decimal equivalents to fractions.

Get as much info on the subject as you can

- Google is your friend. Google Images is your BEST friend.
- Not all websites will let you download or save images, but the snipping tool can be used to capture the image.
- Gather it all together and look at what you have. Do you have views of all sides?

Have a few basic tools on hand

Work Surface and Layout

- Rubber cutting boards are OK, but too 'soft'.
- Important to have a flat surface that you can cut and glue on; get a piece of glass.
- Critical to build your basic structure as square as possible; get a small machinist square.
- Handy to have a square corner to build against; get a small V block with machined faces, which is also useful to support round pieces

Have a few basic tools on hand

Measuring and marking

- Steel rule, with decimal graduations. Get the type with machined edges and graduations right to the ends; useful for measuring into a corner.
- Cheap plastic geometry set; sometimes you need to mark an angle with a protractor.
- Circle template; useful for marking corner radii.
- Digital caliper. An essential tool for all sorts of measuring.
- You will need some fine point permanent ink markers or sharp soft pencils for marking cuts.
- Don't forget that calculator.

Have a few basic tools on hand

Cutting and scribing

- Your favourite hobby knife and LOTS of replacement blades; blades should be pointed, not curved.
- Steel ruler for measuring and scribing against.
- Razor saw for cutting. I use larger saws rather than new-style etched blades because we are talking construction work, not detailing at this point.
- ‘Waldron’ style punches, but also plain paper punch

Have a few basic tools on hand

Gluing and Filling

- Liquid cement. I use Testors because it doesn't evaporate as quickly as some.
- Cyanoacrylate glue and accelerator.
- Epoxy putty. I strongly recommend Quikwood from Lee Valley Tools; much better than Milliput.
- Your favourite seam filler. I use Bondo Spot putty but Tamiya is also good.
- Cutex nail polish remover and Q-Tips. These will remove filler without damaging the plastic beside the seam.

Have a few basic tools on hand

Grinding and Filing

- A small grinder can be very useful, but make sure you get variable speed. Most Dremels are much too fast and will melt plastic.
- A couple good flat files. I use 4" or 6" Warding files, with a bastard cut (not single cut).
- A few round files. Chain saw sharpening files come from 1/8" to 5/16" diameters.
- An inexpensive set of miniature files.
- A good rasp. Lee Valley Tools sells a nice one. It looks nasty, but sometimes you just need to rough out material.

Have a few basic tools on hand

Sanding and Finishing

- Make a flat sanding board. I use a piece of aluminum about 4" x 6", cut medium and coarse wet and dry paper to size and glue on with spray adhesive. Don't use double sided tape as it adds flexibility and creases.
- For dry sanding, I use foam backed emery boards.
- For wet sanding, I make my own sanding blocks from foam sheet and wet-and-dry sandpaper, in various grits from 220 up to 1500.
- A Spot Sanding Pen from Canadian Tire is great for restoring the surface finish after gluing

Materials: Learn to love plastic in all its forms

- The basic building material: Polystyrene sheet. Available from 0.010" to 0.125", you should have a selection. The most used will be 0.040".
- Evergreen polystyrene strip, available in a wide variety of rectangular, round and other shapes.
- Brass and copper wire, available in straight lengths from hobby shops and rolls from beading stores.
- Lead wire, available from outdoor stores like Bass Pro Shop. Ask for fly tying wire.
- I don't recommend carving wood. It is too soft, and difficult to finish smoothly. Mix up some Quikwood epoxy as it files well and sands very smooth.

Start cutting, gluing and sanding

- Basic scratchbuilding is starting with a simple shape, and adding layers and details as required.
- The MOST IMPORTANT STEP is to start square and build from there. Check EACH cut for squareness.
- Check each cut piece dimensions. Better to cut oversize and sand/file to size than cut too small. When sanding cut edges, use the flat sanding block and check frequently.
- For basic structures, use 0.040" or 0.060" sheet as material. It is much more rigid, and less likely to warp, than thinner stock.
- If you need to cut two identical pieces, cut one to size, and the other oversize. Tack them together with a small drop of cyanoacrylate. Trim the oversized piece and when both are the same, slip a knife between and pop them apart. Sand the area where the glue was.

Keep cutting, gluing and sanding

- To build a rectangular box, paint liquid glue on one edge of one piece and attach the next piece. Set them down on the glass, put the corner up against your square or V-block and make sure the joint is square. You can put a drop of cyano on the inside to hold the joint in place.
- Add the corner piece and keep working, always checking the squareness.
- Remember to account for thickness when you cut the pieces. That's why the calculator is always on hand.
- Be sparing in the use of liquid glue. If you need to laminate larger pieces of plastic, it is better to glue them with cyano, because flooding the surface with liquid glue will result in those pieces warping and bending as the glue dries.
- Let basic boxes set overnight to fully harden. Sand the surfaces and check dimensions.

Keep cutting, gluing and sanding

- It is always easier to add detail rather than subtract. Many detail components can be made by cutting and laminating small pieces of thin strip, cut to size
- Can represent hinges with two flat pieces of strip, and a length of round strip.
- Louvred hatches can be represented by using Evergreen siding.
- Don't use woven screen; it unravels and is difficult to get straight edges. Use photoetched brass or aluminum screen instead.
- Non-skid surfaces are available in a number of styles as photoetched sheets.
- Large bolt heads can be made from slicing hexagonal strip. It is possible to stretch strip like sprue, but for really small bolt heads, use round strip instead.
- For dome-head rivets, use brass or plastic rivets for large ones, sliced round strip (lightly sanded afterwards) for medium ones and use dimensional paint for small ones.
- For lines of rivets, use Archer or Micromark rivet decals.
- For weld beads, use stretched sprue (painted with liquid glue and textured) or Archer decals.

Keep cutting, gluing and sanding

- I like Testors liquid glue for most construction. Tamiya Extra Thin is also good.
- If you are gluing ABS or other types of plastic than polystyrene, you will need to use a 'hotter' adhesive like Tenax or MBS solvent.
- Cyanoacrylates are indispensable but difficult to use sparingly. I will try to tack the thing in place with regular glue, then using a needle or special cyano applicator, just allow a drop to run around the object to hold it in place. Carefully remove the excess cyano immediately, and give it a quick spray with accelerator. Note that the accelerator remains on the surface until washed off, so your next drop of cyano may just bead on the surface if it has not been cleaned.
- Epoxy putties are great for building up non-rectilinear shapes. I use Quikwood from Lee Valley Tools exclusively. Peel back the covering, use a sharp knife to cut a thin sliver off the open end, cut a small length and fold and roll. When you think it's well mixed, fold and roll some more. Press it into place and form it roughly into place. Use a wet finger to smooth it in place. With practice, you can get so you need very little filing and sanding afterwards. It files well but will clog up the file so the key is to use a rasp to roughly shape it, and sandpaper to do final finish. You can add more putty later if needed.

Keep cutting, gluing and sanding

- Use a combination of scribing and sprue for a number of effects.
- For raised ribs on metal fenders: Scribe the crossed pattern in the base plastic, glue round strip in the scribed slots, fill gaps with putty and use Cutex to rub away excess putty everywhere but alongside the strip. You don't want to sand because you don't want to flatten the strip.
- For fabric areas on aircraft: Scribe the stringer pattern, glue round strip in the scribed slots, use your fingertip to smear putty between the stringers. You can sand these afterwards but use a rounded sanding block. You want to end up with a subtle scalloped effect.
- Don't try to reproduce the fabric texture for aircraft. On doped aircraft, the surface is as smooth as metal.
- When done detailing, give the area a coat of Tamiya primer. It is an excellent primer straight from the can. However, small items will not adhere as well to a primed surface as to bare plastic, so wait until you are completed to prime the model.