

Models Help Projects Succeed

Prototypes of cardboard, foam or paper help solve design and construction problems

by Jan Zaitlin



Big or small, models help refine design—The author uses three kinds of models to help her visualize furniture projects before they are built. Full-size mock-ups can be assembled quickly with cardboard and straight pins, as she does here.

I'm a big fan of making models and mock-ups before I move on to a finished piece of furniture. Whether the prototypes are cardboard or foam, full size or one-eighth scale, they help solve a long list of furnituremaking problems. Models are good for demonstrating knockdown features and can help me decide what construction techniques to use. Clients love models because visualizing the real thing from drawings can be difficult; models can show clients how finished pieces will look in their intended room settings. Even if I'm building a project for myself, a quick model can prevent disappointments later.

I use several types of models, and the applications and the materials for each vary. I have three favorites: the quick, full-scale mock-up, what I call the scale appearance model, and the full-size detail mock-up like the one in the photo above.

A quick, full-scale mock-up

A mock-up is a quick, inexpensive, full-scale, approximation of the completed piece. The purpose is to catch any obvious mistakes in proportion. I usually build one right after I have my design concept drawn, dimensioned and approved. The mock-up shouldn't take more than an hour to construct and should be taken to the site. There, I can tell if the finished piece will be the right size for the intended space, if it blocks too much light or if its position or dimensions will cause some other unexpected problem, such as limiting the swing of a door. If the project is a dining table, I can place chairs around the mock-up to see if it makes the room seem too crowded, allows room for serving platters and seats the required number of people comfortably.

I use inexpensive materials that can be worked quickly. Mock-

ups need not be pretty. For most projects, I use corrugated cardboard, which can be used for curved as well as angular projects because I can bend it with the “grain.” And I can draw on it with a pencil or marker to suggest details.

Sometimes the appropriate mock-up material is foam board, polystyrene foam sandwiched between smooth paper. Foam board looks cleaner than cardboard, and it doesn't have the strong grain that corrugated cardboard has. It is available at art and architectural supply stores and comes in a range of thicknesses ($\frac{1}{8}$ in., $\frac{3}{16}$ in., $\frac{1}{2}$ in.) and in sheet sizes up to 4 ft. by 8 ft.

Both foam board and cardboard are easily cut with a utility knife. I use a cordless hot-melt glue gun for quick assembly. On those occasions where hot-melt glue is not appropriate (it can be messy and thick), I have used a quick-drying white glue called Elmer's Tacky Glue. I also use a variety of tapes including repositionable tape, which is good for changing things around. Check the adhesives section in art or graphic supply stores.

A handy fastener for butt joining is an ordinary straight pin, the kind used by tailors to hold fabric together. These are available at fabric stores and often at grocery and drug stores. Straight pins are great for making a knockdown mock-up (see the photo on the facing page).

For more sculptural applications, such as a chair or lamp base, or wherever it is important to show mass, I use rigid blue foam (extruded polystyrene). It is used in construction as insulation and comes in 2-ft. by 8-ft. sheets, 1 in. and 2 in. thick. Avoid the white foam. It breaks up into little pellets and doesn't sand well. 3M makes a spray adhesive especially for foam that bonds almost instantly, so you can stack up layers of foam to get a mass of material very quickly.

Blue foam can be worked quickly with most woodworking machinery and hand tools. The board can cut cleanly with both a bandsaw and a tablesaw, sanded quickly with a disc sander (be sure to use a dust mask) or sculpted with a Surform tool or a file (see the photo above).

Other materials are also useful for mock-ups: scrap wood for those times when cardboard just isn't strong enough, aluminum foil to simulate a mirror or metal parts and construction paper or poster board bent, cut or used like a veneer. Be creative.

When you build your mock-up, it's a good idea to make it easy to alter, so you can make changes without too much trouble. After all, you're really trying to see how the shape and proportion work, so a mock-up that's easy to adjust will be a lot more helpful than one with permanent joints. Be sure it is easy to disassemble, so the mock-up can be moved to a site or stored until completion of the real piece. Don't be tempted to toss the mock-up before the piece is completed. It will come in handy when you need to try out design changes that occur in mid-project.

A scale appearance model

After the mock-up, I consider making an appearance model—a scale model that looks like the real piece only smaller. I make appearance models when I am designing a piece for production or if a one-of-a-kind piece is particularly sculptural, uses unusual

construction techniques or if the concept cannot be conveyed adequately with a drawing. A model gives a more realistic sense of the finished piece, especially if your drawing skills are weak; it makes a great presentation tool, and it can be used to create photos of a room setting when the job site isn't available for a mock-up. A nice appearance model takes a day or two to build.

I make appearance models of furniture at one-eighth or one-quarter scale, according to the size of the project. It's best not to go overboard on detail, or the model begins to look too cute, like doll furniture. Small details also take time to do well and often don't tell you much. If they are really important, do the third type of model, a full-scale detail mock-up. More on that later.

Wood is the primary material on most of my appearance models. I used to mill my own small stock, but I found that it was time-consuming to cut the very thin stock that is necessary. And quite often, the quality was not as good as the store-bought model-making material. It can be tricky to mill small stock without having it explode in the planer or chip badly. Many hobby shops and architectural supply stores carry a good selection of basswood, cherry and walnut. I avoid balsa because it doesn't cut cleanly.



Cushion that's really foam—High-density, white polyurethane foam shapes easily and is perfect to mimic upholstery in scale models.

Many of the places that carry model-making supplies also sell ultra-thin plywood. I have seen three-layer sheets (1 ft. by 2 ft.) of ply as thin as $\frac{1}{64}$ in.

When the project calls for a substance other than wood, I use a variety of materials. The blue foam mentioned earlier is good for simulating the pleats, folds and soft look of upholstery. There is a better quality, white, high-density polyurethane foam available in sheets $\frac{1}{4}$ in. to 2 in. thick that is more expensive but holds details better and is more uniform (see the photo above). You can paint it with acrylic paint.

Acrylic sheet or rod can be used to simulate metal or glass. It can be bent with heat from a heat gun, torch or in an oven and painted with a metallic paint. I have used pieces of acrylic sheet to simulate glass tabletops by painting the edges green (a light green marker is even easier).

Painted wood used to offend the woodworking purist in me. But now I see that it can be used to simulate other materials. For example, there are faux marble paint kits available in paint stores or art supply stores, so you can machine a tabletop in wood and then make it look like marble or granite. To make the patterns look right on scale models, you may have to alter your technique slightly. For instance, to get a smaller pattern that looks right, a tight-pored sponge, like a sea sponge, works best for marbling.

Don't overlook paper as a model-making material. When used like a veneer, it is quicker than paint and can simulate laminates

and stone. Art or graphic supply stores carry paper in glossy or matte finishes, and the number of colors will surprise you. Ask for Pantone paper. While you are in the graphics department, get a can of instant spray adhesive made just for paper.

And don't leave until you check out some markers, pencils and press-on stripes and patterns. Architects and designers use these to simulate details; you can too. You can draw on inlays or drawer and door lines. A dot can simulate a knob, a horizontal line can suggest a wire pull and markers can simulate aniline dyes. There are wood-colored markers, but you need to test the color to see if it approximates the real wood color.

Special tools help model making—Though the construction of scale models can be relatively quick, it requires some special tools

Simple fixture makes cutting small model parts safer—The author made a small crosscut fixture for her radial-arm saw to reduce the danger of small parts getting pushed through the big gap in a standard saw fence.



Detail mock-ups test alternatives—The author used white foam to make a full-size detail mock-up of a cabinet handle. Several options can be made as detail mock-ups and then tried out on the quick, full-size mock-up.



and fixtures to make the machining of small parts safe and accurate. For example, I made a small-parts crosscut jig for my radial-arm saw (see the top photo). The jig helps block off the big gap in the fence that could swallow up small parts as they are being cut to length.

To deal with this gap problem on the tablesaw, I made a wooden throat plate with a narrow slot. I also can rip thin material on the tablesaw without having it slip under the bottom edge of the fence by using an easily installed facing for the fence that goes all the way down to the table surface. I always use push sticks; sometimes I use two, one in each hand. Featherboards are also good for keeping your fingers away from the cutting edges.

Joinery for models—I often simplify the joinery on appearance models. I use butt joints when I can get away with it, but I also use thin dowels or wooden toothpicks for through-dowel joints when necessary. Dado joints are pretty easy with a router table and 1/16-in. and 1/8-in. straight bits. Make certain that the hole in the table

is not so large that it creates a safety hazard when machining small parts. I use little De-Sta-Co clamps to make quick jigs to hold the small parts when I machine them on the router table.

Mortise-and-tenon joinery may seem a bit extreme, but occasionally, I find that it provides detailing important to the look of the finished piece. And it may help hold the model together. I drill out holes and clean out corners just like I do in full-scale mortise joints, but I use a shopmade 1/16-in. chisel. I made the chisel by grinding the tang end of an old, dull file. The steel is hard enough to keep an edge.

One store-bought model-making tool that I find useful is the tiny brass bar clamp. I got a pair of them as a gift and thought I would never use them, but the bar clamps are handy because they fit in small places. Other good clamping tools are clothespins, paper clips, tape and rubber bands.

Scaled construction hints at real problems—Although the tools are smaller, scale model making provides a good opportunity to think through the whole construction process on full-scale pieces.

As I build the model, I imagine that I am doing everything in full scale, and based on that experience, I choose the best construction technique for the real piece. It is important to remember, however, that if a construction operation or detail is easy in scale, it may not be when it is full size and vice versa. For example, once I neglected to account for how difficult it

would be to lift a glass top in and out of a frame repeatedly to get a perfect fit; on the model, it was easy to fit because the small piece of acrylic was so light. Conversely, some things can be awkward on a scale model because the access is tight or the parts are so small that clamping is difficult, but on the real thing, access may be a simple matter of reaching your arm inside of a cabinet or using a bar clamp.

Full-scale detail mock-up

Mies van der Rohe, the famous architect, once said, "God is in the details." So when I am working on a piece that has unusual edge or surface treatment, a unique pull, connection or foot, I mock up just the detail. The full-scale detail mock-up lets you see your design in three dimensions. If you have already made a full-scale mock-up of the entire piece, then it's a good idea to attach this detail mock-up to it (see the bottom photo on this page). Work precisely on the detail mock-up so that you can work from it to build the real thing.

My material of choice is foam, both the blue and white types discussed earlier, because foam is so easy to work. When I use wood, I prefer something that can be worked easily, such as pine. Wood is the obvious choice if the detail is turned on the lathe or if it requires a texture that cannot be expressed in some other quickly worked material. □

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Photos make models look real



Models let you look at the result in advance. This scale model of a conference table comes to life when photographed with a few props and an appropriate background. Cardboard or clear acrylic human figures add scale.

Scale models that are made with care can be photographed to look like full-size pieces, as shown above. This is a great design and presentation tool.

Determine the background:

The easiest background is a sheet of paper large enough to fill the picture frame. Use any color paper as long as it isn't glossy. Bend the paper, don't crease it, so it sits on a tabletop and runs up a wall behind the table. For a more dramatic effect, use a roll of background paper, available in a variety of colors from professional photo supply stores. Tack one end to the wall, and put a table about 3 ft. away from the wall. Roll the paper onto the table, and set the roll on the floor. Place the model on the paper near the front of the table, and focus light there. The background fades into darkness, which contrasts with the lighted model.

Photos of the piece on site:

To see what the piece will look like on site, I use three pieces of foam board taped together on the back side to form two walls and a floor large enough to

house the model and fill the picture frame (see the bottom photo). To give a sense of scale, I use a few props. This can be as simple to do as drawing an outline of a door with a circle for a knob at the right height. When I was photographing a model of an audio-visual storage system, I drew a screen on a cardboard television set, which was just a rectangle of gray cardboard propped up from behind with a little cardboard triangle.

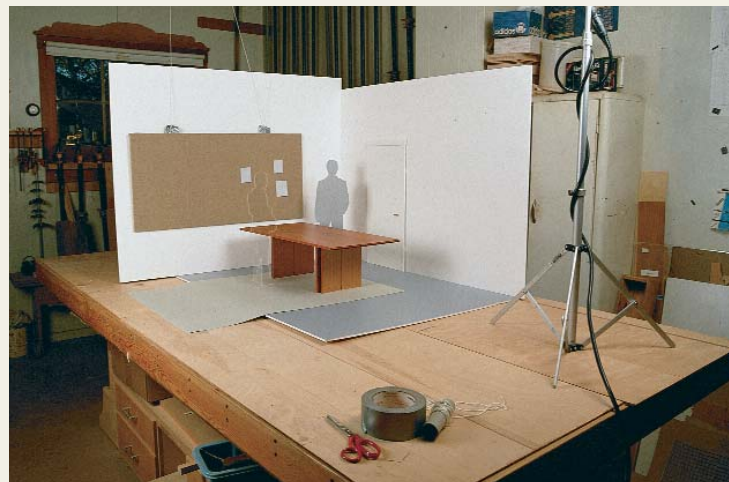
Figures add human dimension:

I find scale figures help-

ful, too. You can make a quick one by photocopying a figure from an architectural graphics book or a department store advertisement. Enlarge or reduce the figure until it is the right size. Use spray mount to fix the figure as a cutting guide to any rigid, thin material, like 1/8-in. acrylic. Then glue a small triangle to the back of the figure to make it stand on its own.

Photo tips: In addition to a 35mm camera, I would suggest that you use a macro lens or a set of magnifying lenses, called

close-up filters, which screw onto a lens to allow you to focus at much closer distances than standard lenses. A tripod and a cable shutter release allow you to snap a shot without wiggling the camera. Light stands can be fashioned with clamp-on shop lights and a chair for a stand. But daylight shooting is often quicker and can be just as effective. Just be sure that your film is matched to whatever lighting you choose. Any good photo supply store can give you advice on choosing the correct film. —J.Z.



Three pieces of foam board can make a room—With the camera pulled back, the illusion is revealed. The backdrop is held up by string and tape. Simple shop-style clamp lights can substitute for the electronic flash shown here.