Foam Core Prototyping Techniques

Handcrafting architecture and product models

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I find that prototyping techniques are craft skills best learned by making mistakes. Practice makes perfect but practicing under a deadline can use a guide. This paper is intended to fill a need for a basic introduction to the techniques specific to the material called foam core or paper-faced foam board.

Basics

My experience has been that the best glue for working with foam core is hot glue. Reducing the time waiting for the glue to set increases the speed with which you can assembly a model. The main issue with this adhesive is that the heat from the glue melts the foam. As well, if messes need to be cleaned up it can damage the paper surfacing. If caution and dexterity are used, there is rarely a problem. To accelerate the solidification of the glue a jet of compressed air, figure 2, can be used to cool the area.

Figure 1 Hot Glue

Figure 2 Blow Dry

A small tool can be constructed to carve wedges out of one face of the foam core so that curved surfaces can be constructed at a faster pace. This tool, figure 3, can be assembled from two blades and a scrap piece of wood. A similar tool is available commercially called a Mayline and is sold as a tool for cutting cardboard used in decorative framing. To make the most efficient use of foam core use the scraps as reinforcing, figure 4, on the inner surfaces. This helps add strength to the model and prevents any possible warping that can occur latter due to humidity changes.

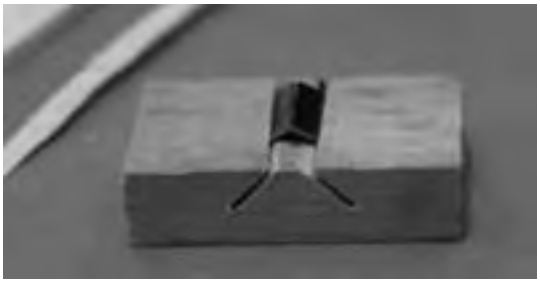

Figure 3 Groove Cutting Tool

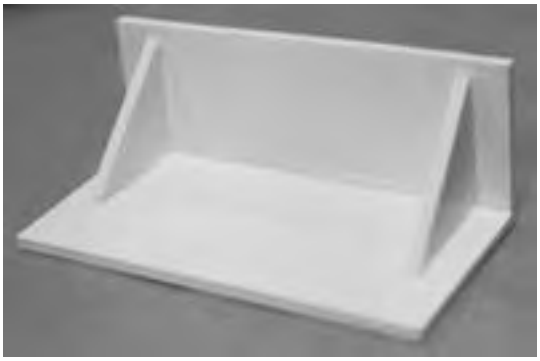

Figure 4 Reinforcing

Details, figure 5, can be added at a later stage by quickly mocking up shaded details in a computer graphics program or by photocopying parts of actual products. These details help communicate the design during user testing or presentations.

Figure 5 Detailing

Edges

Edges can be cut and glued using a groove method. This is the best method for gluing the edges of two sheets together with a presentable result. The first step is to mark the thickness of the sheet to be glued, figure 6. Next cut through the external paper covering to a depth that cuts through the foam but not the other side of the paper backing, figure 7. A piece of tape on the blade can be used as a guide until sufficient familiarity and dexterity is achieved, figure 8.

Figure 6 Mark Edge

Figure 7 Cut Edge

Figure 8 Tape Guide

The foam is then separated on the next cut; figure 9, which should be a slight distance away from the paper backing to prevent accidental cuts through it. Any remaining foam can be crushed or sanded off with a quick pass with a file, figure 10.

Figure 9 Cut Foam

Figure 10 File Foam Core

The two pieces can then be bonded with a strip of hot glue, figure 11. It is best to put the line of glue on the paper backing and press the unprepared edge into the glue. This is because the heat from the glue causes the foam to out gas and creates a bubbly mass of glue that can create quite a mess or the foam can shrink away taking the glue with it.

Figure 11 Edge Gluing

When exact angles are required a jig should be constructed in which the pieces can be held as the hot

glue sets, figure 12, or reinforcing can be cut to the exact angle and be used to maintain fit, figure 13.

Figure 12 Edge Glue Jig

Figure 13 Accurate Reinforcing

Angled Edges

For edges at angles other than 90 degrees, both sides of an angled edge must be prepared. One method is to use the measured thickness of your foam core and some trigonometry to calculate the distance from the edge an angled cut would create. Draw a guideline at the calculated distance and cut a wedge out of the exposed end.

t = thickness of the foam core

A = the acute angle of the edge seam

d = distance from edge for guideline

Subtract 90 from the obtuse angle (edges greater than 90 degrees) to get an acute angle.

Make sure your calculator is using degrees by testing that the result of tan(45) = 1.

d = t / tan A

For a 1/4-inch foam core edge at a 30-degree angle, you would need to draw your guideline at 0.433-inches from the edge.

d = 0.25 / tan 30

d = 0.25 / 1.73

d = 0.433 inches (about 7/16")

A table ledge can be used as a guide during the angled cuts, figure 14. The cut surface of the prepared piece is then used as a measure in preparing the second, figure 15.

Figure 14 Cutting With Table Edge

Figure 15 Measuring

If the piece is meant to be an acute angle the inside edge of the second piece should then be cut at the same angle, figure 16. If the angle is meant to be obtuse, the edge is in definite need of reinforcing, figure 17.

Figure 16 Cutting Inside Edge

Figure 17 Reinforcing Outside Edge

Again, the best method for exact angles is to build a jig in which the glue can set. As well, cut reinforcing to the exact angle that can be used to maintain proper fit.

Curved Edges

To create an edge with a radius, mathematics is required to convert the needed radius into a circumference. This circumference is used to measure the linear distance between grooved cuts, figure 18.

r = radius of the edge

a = angle of edge

w = width of channel to clear.

$w = 2 \pi r (a / 360)$

For a 3/4-inch radius at a 90-degree angle, you would need to clear a 1.175-inch channel.

$w = 2 \pi 0.75 (90/360)$

$w = 4.7 (0.25)$

w = 1.175 inches

Figure 18 Cutting Groove

This distance should be hollowed, figure 19, and the piece bent and glued at the appropriate angle, figure 20.

Figure 19 Hollowing Groove

Figure 20 Bend And Glue

This type of edge needs more reinforcing, figure 21, than the usual edges. The results can be quite impressive for a quick mock up, figure 22.

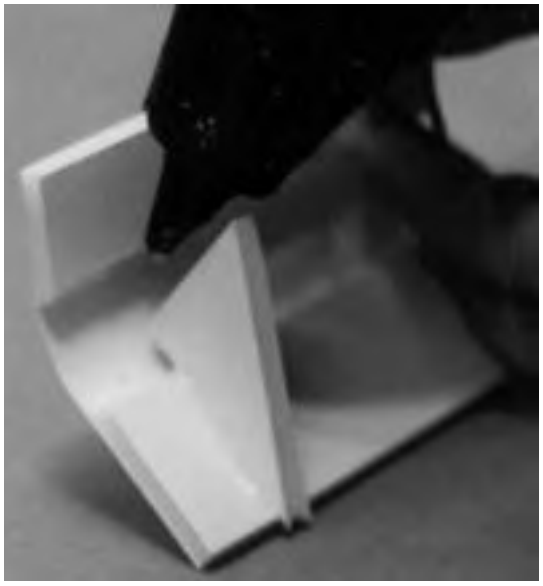

Figure 21 Reinforce

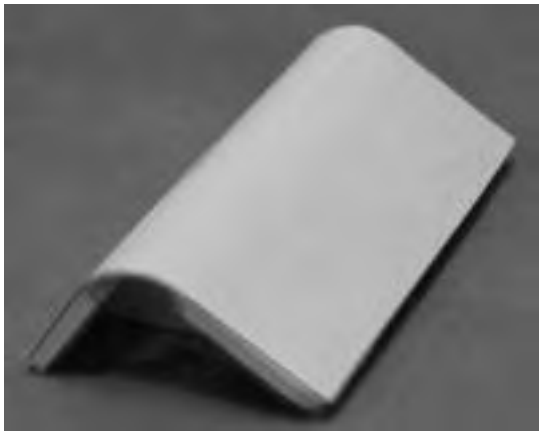

Figure 22 Curved Edge

Curved Surfaces

Curved surfaces require several grooves cut in the foam core to provide a series of bend points. The more bend points the smoother the curve will be, figure 23. Reinforcing ribs are needed to maintain the desired curve, figure 24. The results will depend on the number of and care taken in cutting the grooves, figure 25.

Figure 23 Cutting Grooves

Figure 24 Bend and Glue

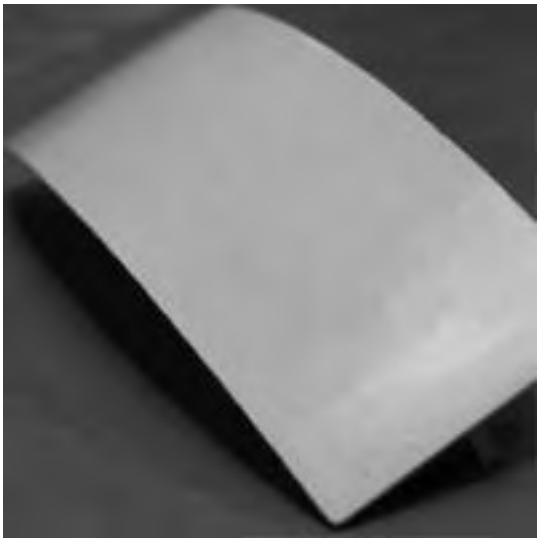

Figure 25 Curved Surface

Prototyping From Drawings

Most designers start with the drawing process and may have full-scale drawings or a 3D computer model may have been used to do initial designs. The drawings, figure 26, generated by these methods may be used to produce a quick model to test volumes and scalar proportions. The fastest method is to use copies of these

drawings as the cutting pattern. Use a light coating of spray glue, figure 27, on the drawings allowing it to dry thoroughly before being temporarily mounted on the foam core.

Figure 26 Drawings

Figure 27 Spray Gluing

The foam core can then be cut to the exact measure of the drawings, figure 28, but be aware that some printers print at a small reduction or can be inaccurate in the printing direction so it is advisable to check the accuracy of drawings before using this method. After the pieces are cut out, the paper can be pealed off easily, figure 29.

Figure 28 Cutting

Figure 29 Pealing

Some glue may remain on the surface of the foam core but this can be removed by rubbing with a rubber cement remover, figure 30. These rubber cement removers are commercially available from any well-stocked art store, figure 31.

Figure 30 Glue Removal