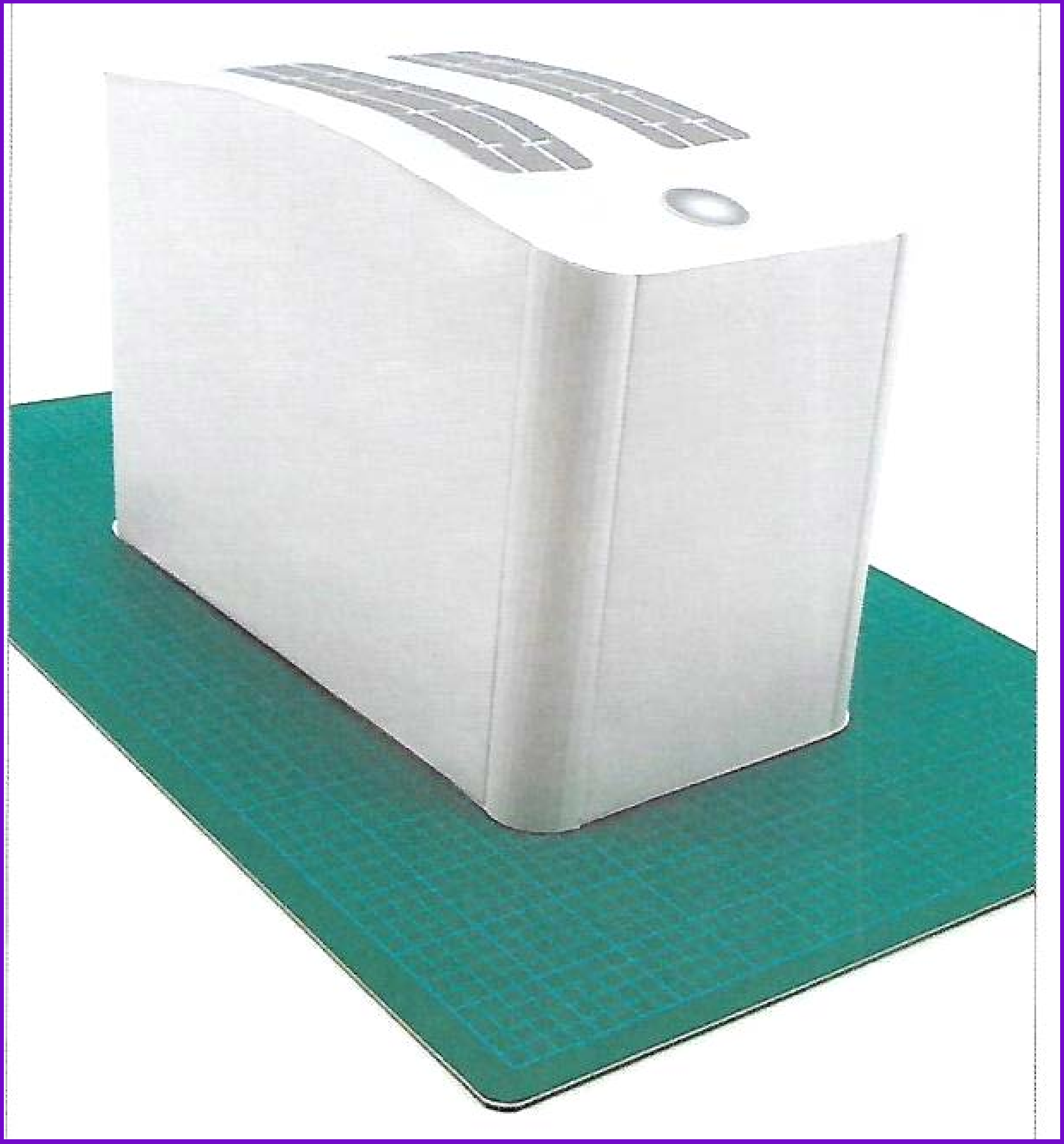
PRO 204 – Modeling Prototyping

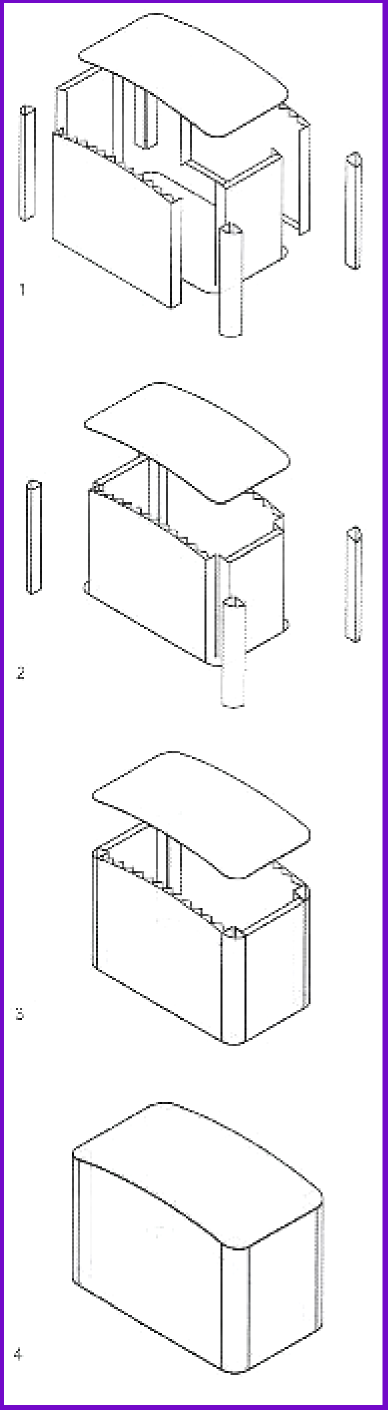
WORKING WITH FOAMBOARD

Tutorial   Bread Toaster

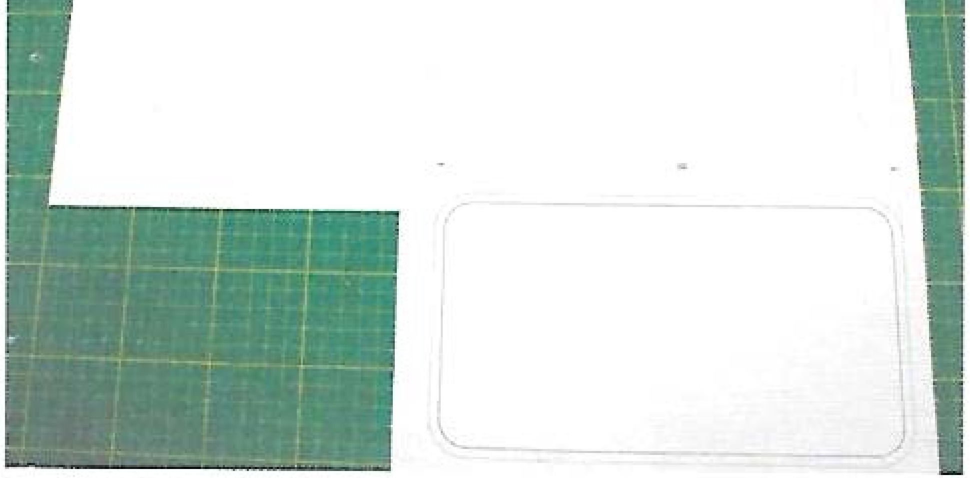
This tutorial shows the benefits of using an inkjet printer to create a visual model in paper. Even a quick model made in paper will be helpful for quickly evaluating overall shape and size. At the same time it is important to realize the limitations of paper; clever methods of folding can be used to create almost any geometry, but the return on invested time quickly diminishes. This example is probably at the limit of what it makes sense to do in paper. For more complex geometry it would be easier to create a cross-sectional model.

These drawings (numbered 1 to 4) show the sequence of construction. All pieces can be made directly from computer printouts, except the corner pieces, which are fabricated by curving pieces of paper. Note how tabs have been entered on the side panels to create stiffness and overlapping joints. Tabs along curved edges have to be notched in order to be folded.



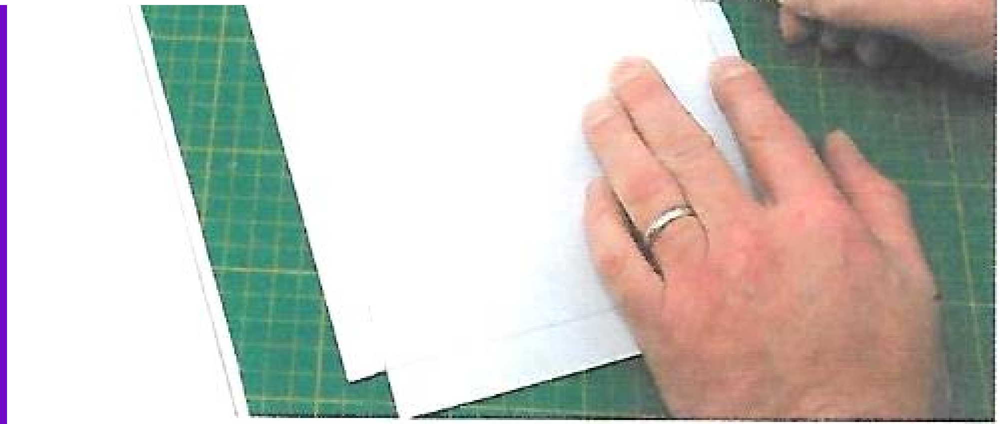


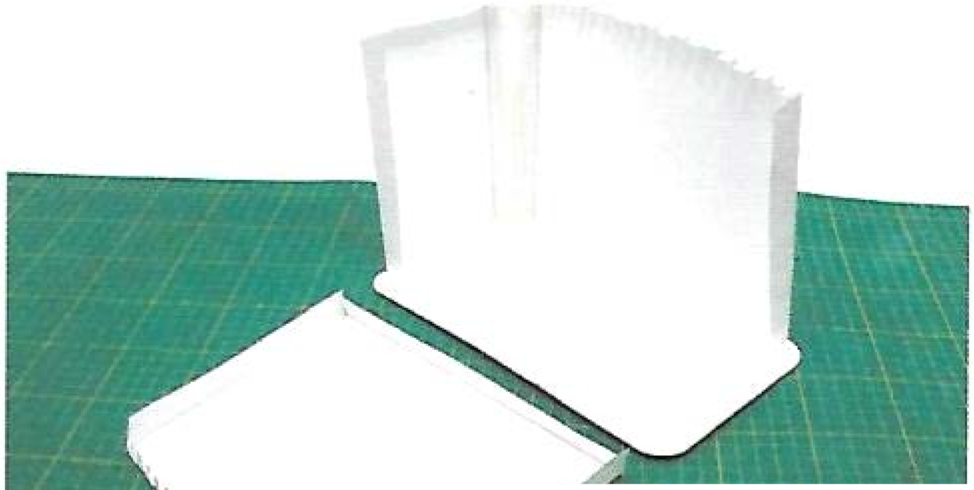
Step 1 Orthographic views of the toaster are created in either CAD or a vector-based program such as Illustrator®. These are printed on sheets of paper.



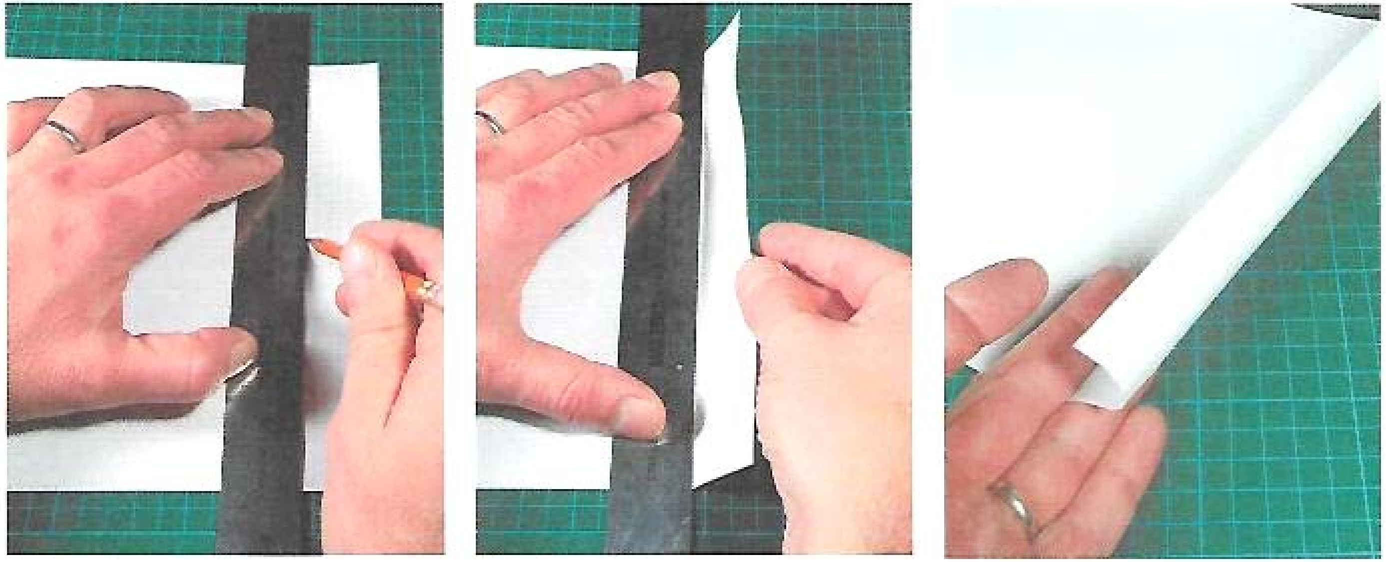
Step 2 In order to add some stiffness to the model, the bottom is glued to a piece of cardboard.

Step 3 Tabs are added manually by offsetting the edges by approximately 1cm (0.4in). Remember that the four vertical corners are shown on the side elevations, but are separate pieces. Tabs that run along curved sections are notched in order to allow them to be bent.



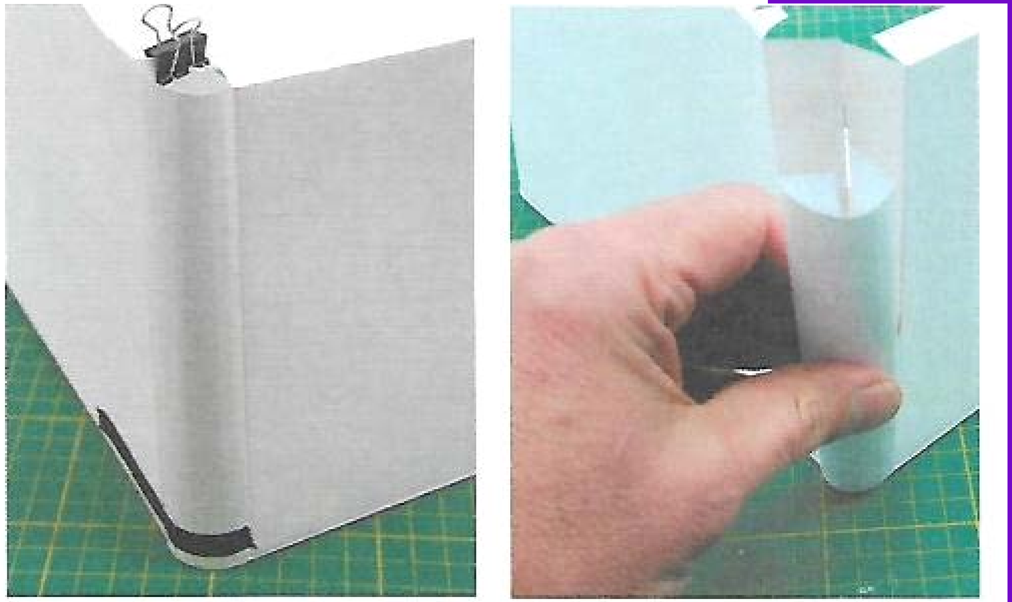


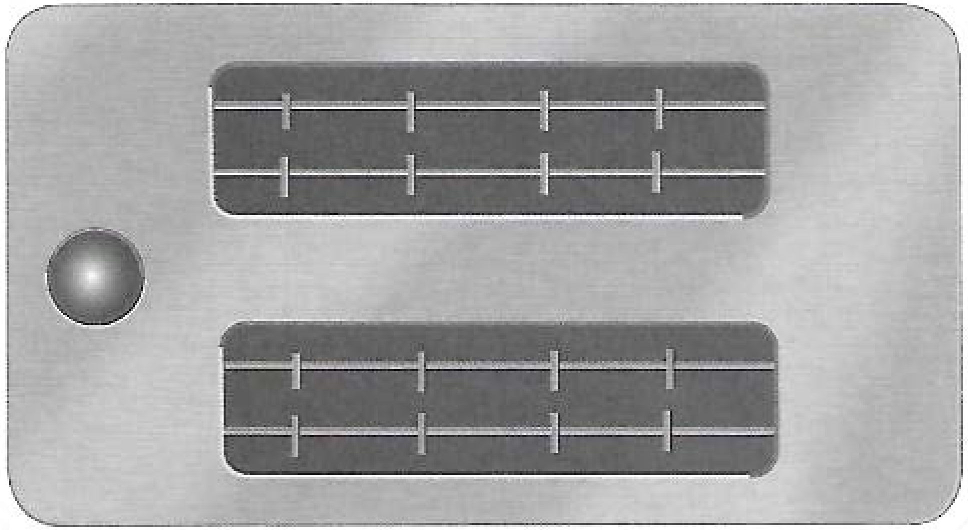
Step 4 The paper panels can now start to be assembled with glue. Tape is also used on the inside to hold the pieces together while they are drying.



Step 5 The corner pieces are curved and cannot be created directly from the elevations. Instead, they are folded with a series of bends using a ruler to curve the paper.

Step 6 The resulting corner posts have to be trimmed to fit and are glued in place with tabs. Small clips or low-stick tape is used to hold the tabs together while drying. The corner posts could also easily have been made in polystyrene foam (see Chapter 14).





Step 7 You can create a high level of realism with a rendering done in Photoshop® and Illustrator®, using the simple techniques shown in the graphics chapter (see page 161). This view can be printed on glossy paper to capture some of the details and then trimmed and glued on to the top of the toaster.

Foamboard

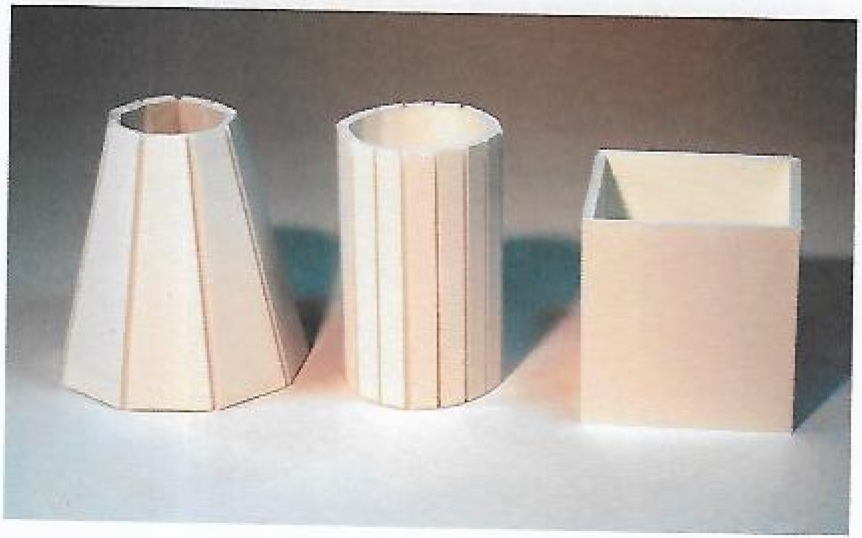
Safety Check

— Read Chapter 5 on health and safety
— Use sharp blades and dispose of in a sharps container
— Use a steel rule as a guide and cut on a cutting mat

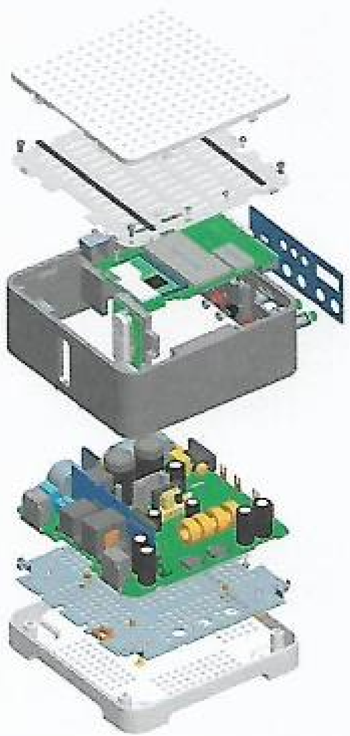
Foamboard is a sheet material consisting of a Styrofoam core laminated between two layers of smooth paper, producing a lightweight yet rigid structure. It is available in various thicknesses typically ranging from 3mm to 13mm (⅛in to ½in), with 6mm (3/16in) being the most common choice. It is easier to work with and produces neater and stronger models than corrugated cardboard. This is because the foam centre produces a uniform solid edge that is also easy to cut. The best source for foamboard is the local art shop, which usually carries a range of thicknesses and sizes, but craft and stationery shops also tend to carry a small selection. Different colours are available, but the standard white is mostly used in practice because of its neutral colour.

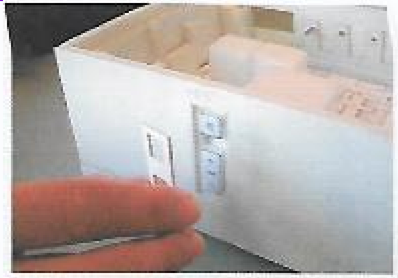
Most geometric shapes can easily be created in foamboard. More advanced organic shapes can also be approximated by a series of cross sections as shown in the previous chapter (see page 89).

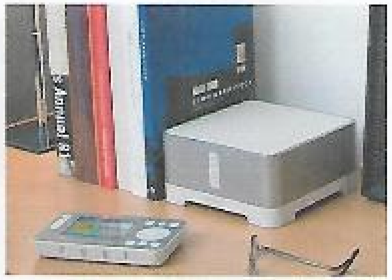
Foamboard is used to study both form and function. The product's internal configuration is often prototyped by using real parts such as batteries, motors and other electronics in conjunction with foamboard. This gives the design team a good idea of assembly and fit. The Sonos ZonePlayer 120 is a wireless digital amplifier whose casing was developed by Y Studios in San Francisco. The designers made extensive use of foamboard in the design process, which allowed them to explore functional as well as visual aspects through this low-fidelity material. The assembly sequence was, for example, explored to test the viability of the product design intent. Real speaker connectors were added to study how they interfaced with the back panel and the circuit boards within. Thinner cardboard was used to simulate circuit boards, with polystyrene foam blocks standing in for electronic components. This example shows how low-fidelity materials can be modified rapidly, thus keeping the design process fluid. The designer gets a good feel of the proportions and complexity early in the process before the design progresses into 3D CAD development.



Foamboard is available in various colours and thicknesses.







Working with Foamboard

Foamboard is similar in function to corrugated cardboard, but more aesthetically pleasing. With a little bit of planning and skill, the foam edge can be hidden, producing neat, clean models. Cutting should always be done on a cutting mat and with a sharp scalpel or Stanley knife. It is a good idea to keep a box of extra blades handy, as these should be replaced at the slightest hint of wear. Most projects will require multiple blade replacements. Thicker-blade utility knives should be avoided, as they tend to crush the board and ruin the edge. The foamboard should always be cut with a minimum of three passes. The first goes through the top paper layer, the second cuts through the foam, and the last cuts through the bottom paper layer. Straight cuts are done with a metal ruler, whereas curves are cut carefully by hand.

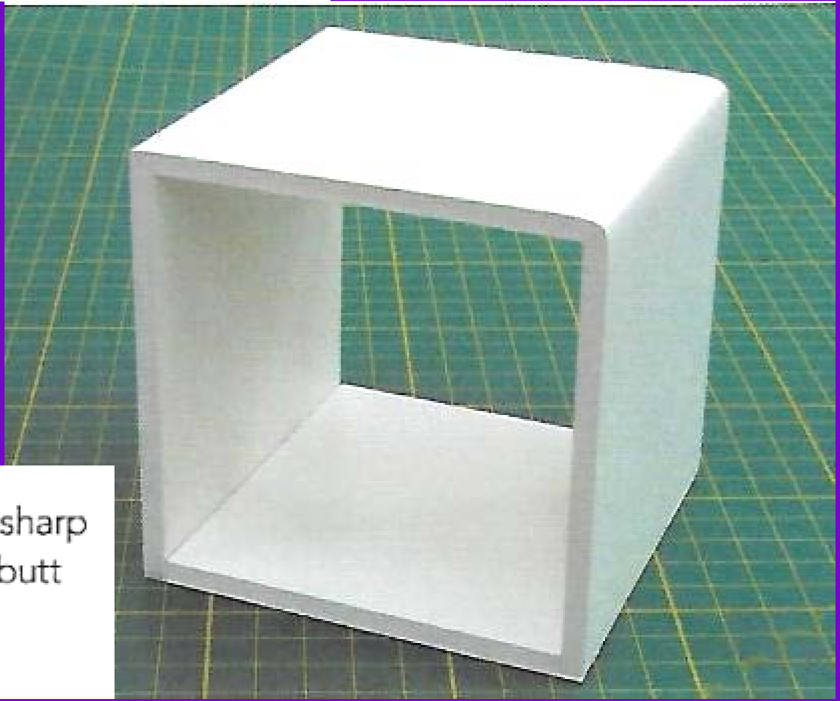
The Sonos ZonePlayer 120 wireless music streaming system was developed by Y Studios for Sonos Inc. in a process that included foamboard low-fidelity prototypes. The foamboard was combined with cardboard (for thinner components) and real off-the-shelf parts

Clean, sharp corners can easily be made to hide the core material and create a continuous exterior surface. Sharp corners at various angles can be made, as well as curved corners of various radii. The level of control over edges is much higher than with corrugated cardboard and is often a reason in itself for choosing this material. Hot glue is mostly used to glue parts together.

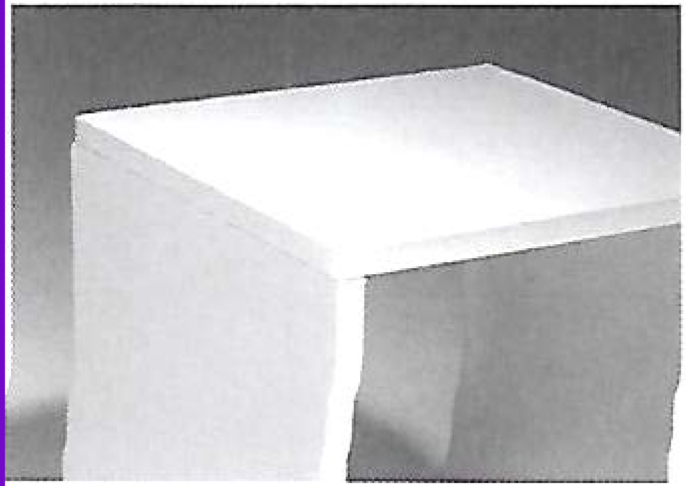
Cutting foamboard with a scalpel requires a steel ruler and several passes.

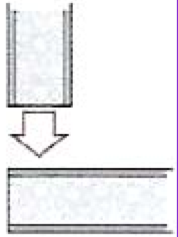
Corners

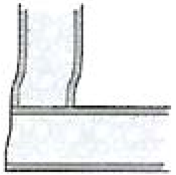
There are four types of corners: simple butt, bevel, folded and rabbet. These corner joints all have their own particular benefits.



Cube with four types of corners: folded sharp (upper left), folded round (upper right), butt (lower left) and rabbet (lower right).





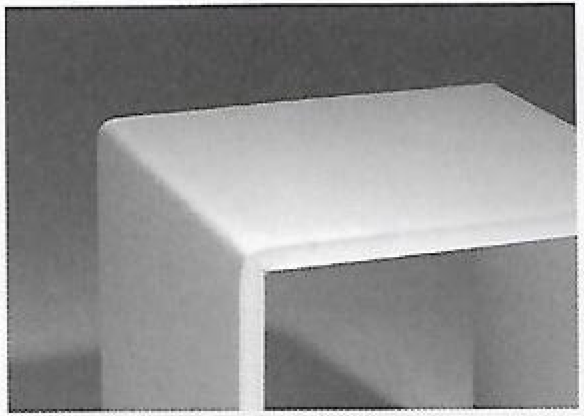


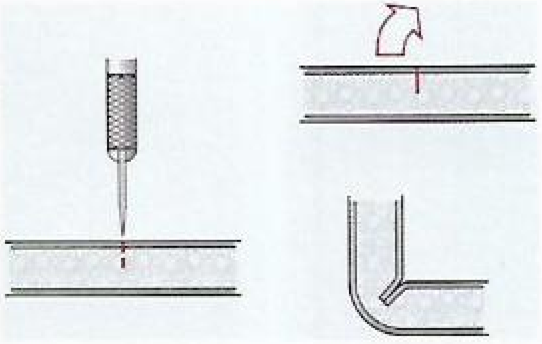
Butt Joint Corner

The simple butt joint is the fastest and most efficient corner, though it exposes the foam from one board. For exploratory work or functional test prototypes this type of joint is often satisfactory.

Folded Round Corner

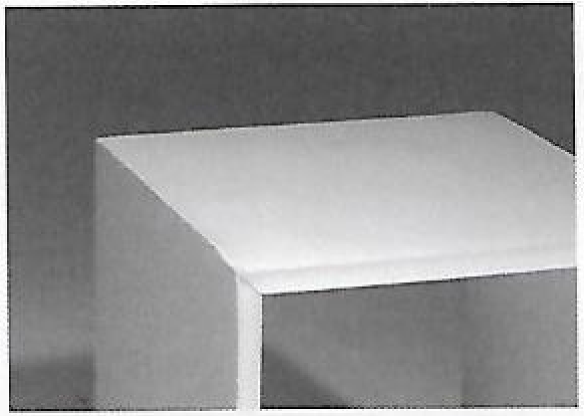
The foamboard is scored on the inside with a partial cut and then bent. This compresses and crushes the core while stretching the outside paper layer enough to create a rounded edge roughly equal to the board thickness.

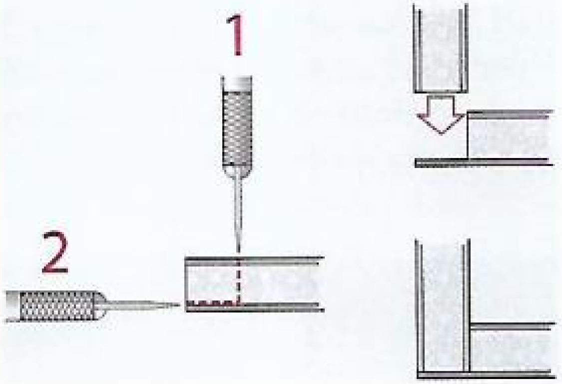




Rabbet Corner

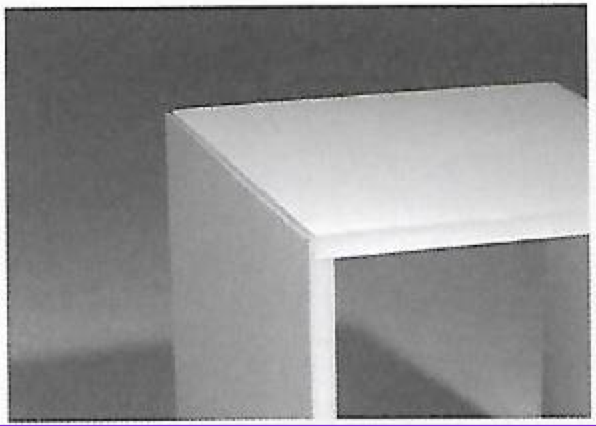
The rabbet corner involves removing a slot in one of the parts, which the other part fits into, effectively hiding the joint. It is especially useful in situations where a piece of foamboard is made to fit over a curve (see tutorial).

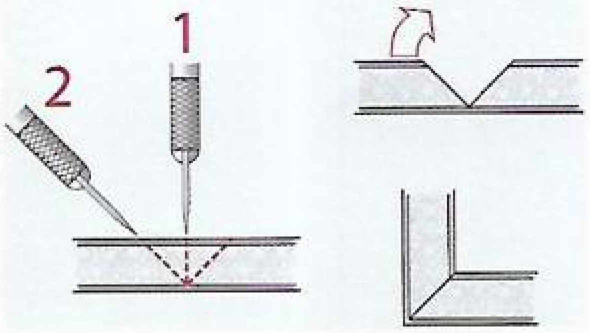




Folded Sharp Corner

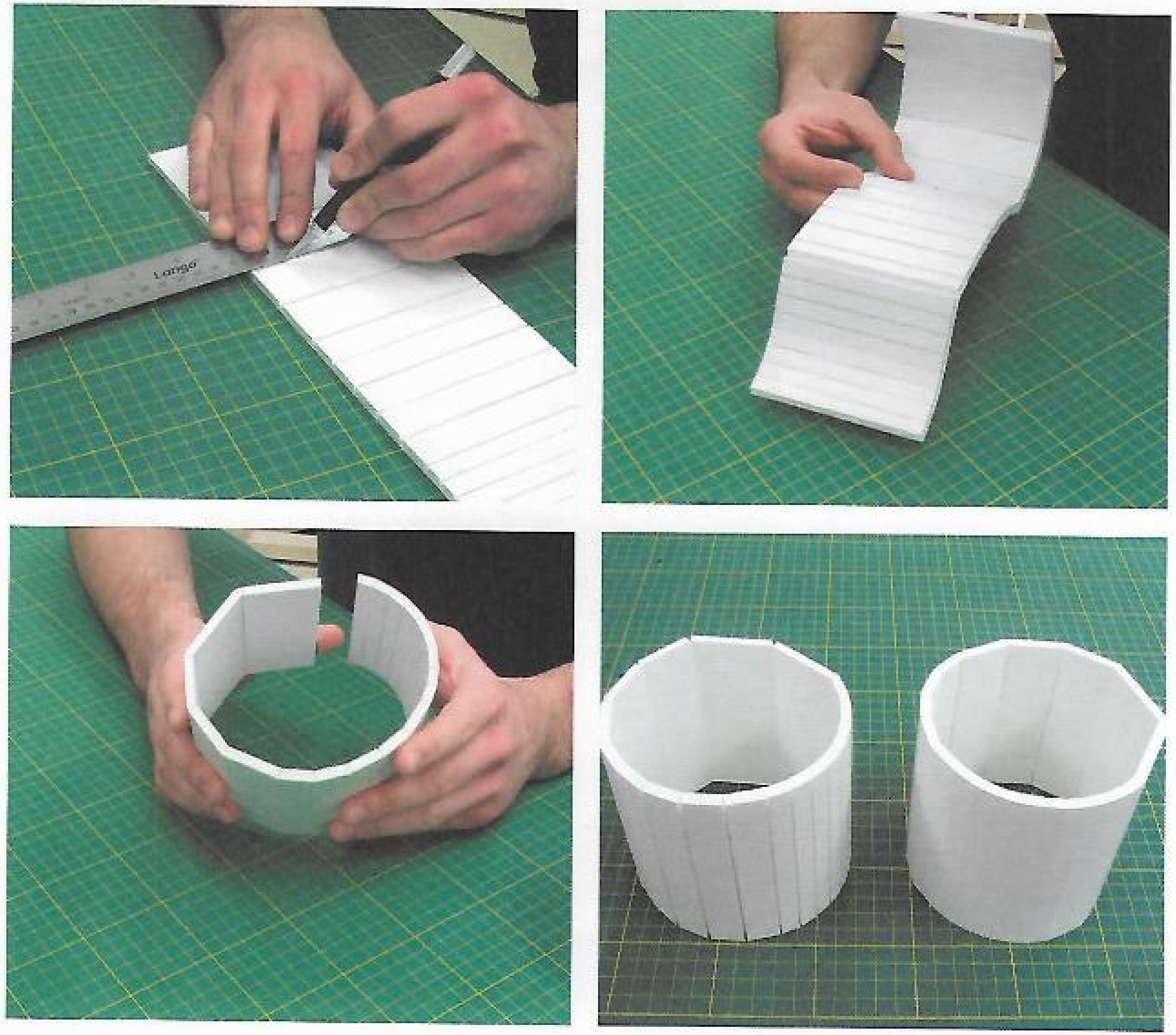
By cutting out a wedge-shaped V-notch of foam, the board can be bent into a tight corner. Obtuse and acute angles are also possible and can be graphically calculated by drawing a V-shaped groove to the required angle on the end of the board. The wedge is then carefully cut so that the blade does not cut through the bottom layer of paper. Bevelled or mitred corners can also be made by mating two different parts that have been trimmed at an angle. In this case each piece would be trimmed to half the total angle.





Curves

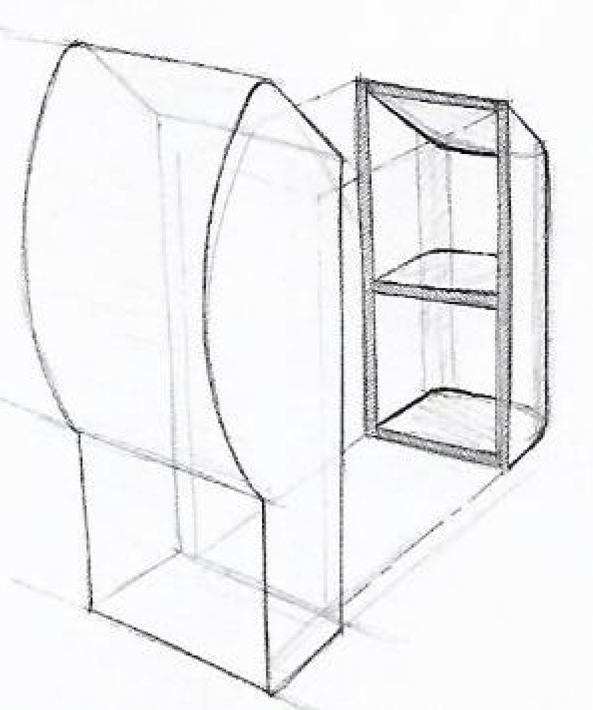
Curved planes and cylinders are formed by approximation. A series of tight folds creates a curve as a series of straight segments. The simplest approach is to score the material at regular intervals and then bend it so that the cuts are on the outside. If a smooth exterior surface is desired then the folds should be on the inside. This usually requires a series of V-notches so that the material can be folded more easily.



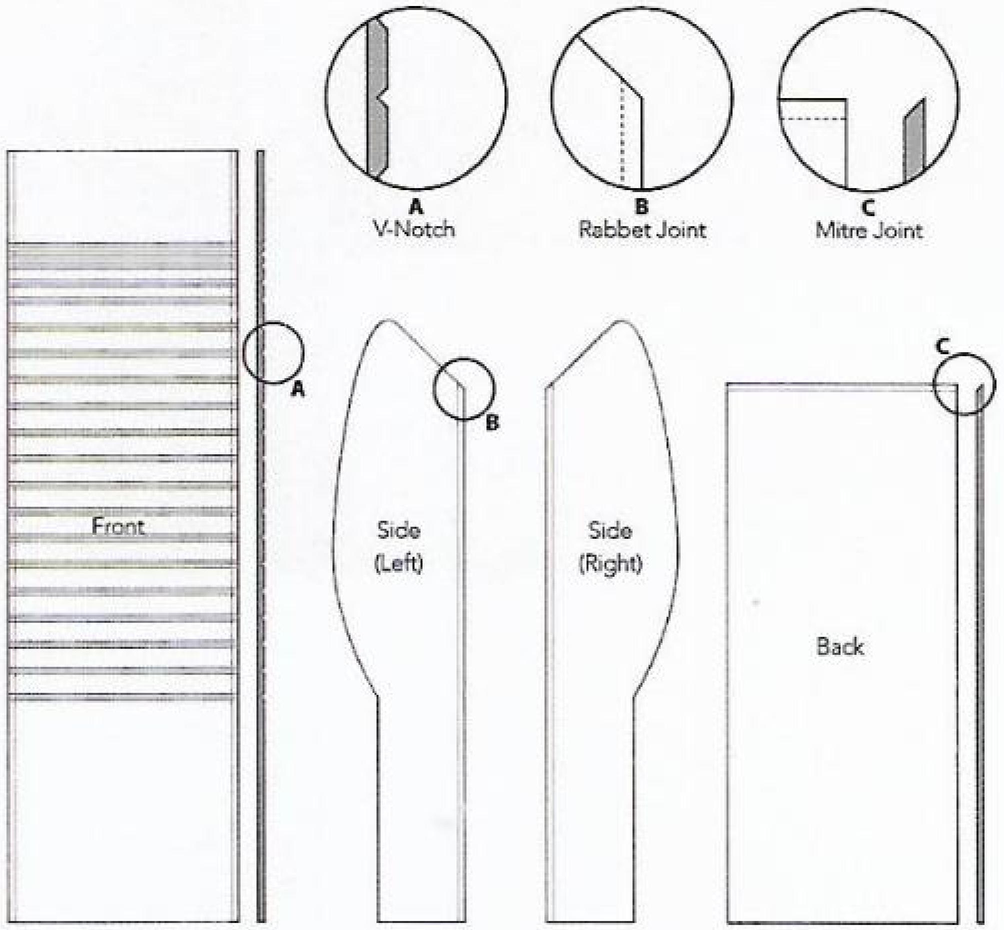
Cylinders and curves are formed by a series of folds. These can be external or internal (above, left and right). The fold spacing affects the smoothness, as shown above.

The large size of a product such as a ticket kiosk makes foamboard a convenient and inexpensive modelling material. This tutorial will highlight techniques that hide the edges of the foam and use custom-rendered decals to illustrate details such as screens and buttons. For the purposes of the tutorial, the model will be built at quarter scale. A full-scale model would be built in the same way using the same materials.

Step 1 A full-scale 2D rendering is created in Illustrator®. The rendering uses a side profile of a person to help govern the placement of the screen.



Step 2 This exploded sketch shows that the kiosk model consists of two sections: a curved front interactive panel and a rear housing section. In terms of manufacturing we are simulating a product that would be made out of plastic and sheet metal.



Step 3 Template patterns are created in Illustrator® using the rendered illustration as an underlay. Five separate pieces are needed for the display section. Dashed lines are used to indicate cuts that do not go through the entire board.

Sekian

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