An Introduction to Package Design

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The Math of Packaging: Does It Add Up?

Part of the design process for packaging is determining the amount of material a package will use and the best way to use available material sizes to produce the package.

Surface Area

The amount of material used is found by determining the surface area of the box. To find the surface area of the pattern, engineers find the total of the areas of all the shapes that make up the pattern. For instance, in the simple box pattern below (Figure 4.1), the area of each of the sections (indicated by dotted lines) can be calculated by multiplying the length of the section by the width of the section (L x W). It is simply the area of each rectangle. To find the total surface area of the pattern, you would add all the areas together.

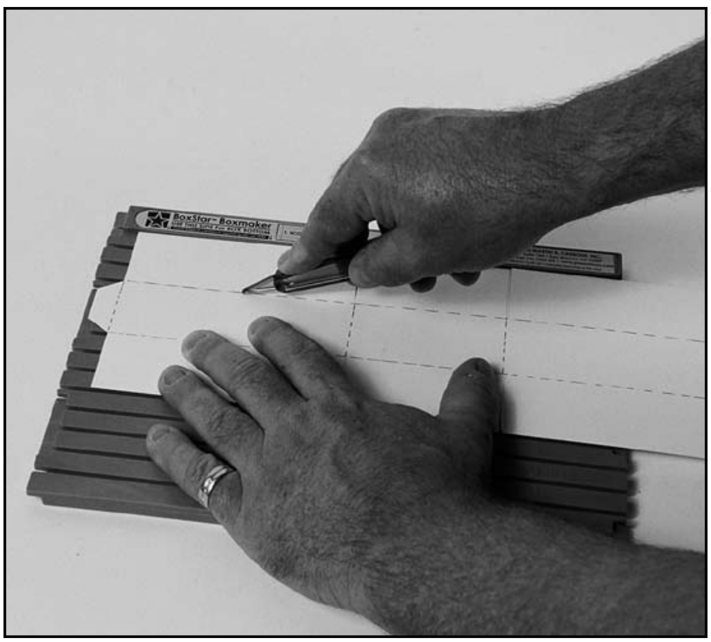


Figure 4.1

However, the surface area of the pattern, or the amount of cardboard used, may be different than the surface area of the final box. This is because some parts of the pattern may fold and overlap. To find the surface area of the final box, you must find the area of each of the outside surfaces of the box.

For an ordinary box, like the one the pattern below makes, there are six surfaces (Figure 4.2). To find the area of each surface (because each surface is a rectangle), we again multiply the length of the rectangle times its width (L x W). Finding the total surface area of the box is accomplished by adding the areas of each of the six surfaces.

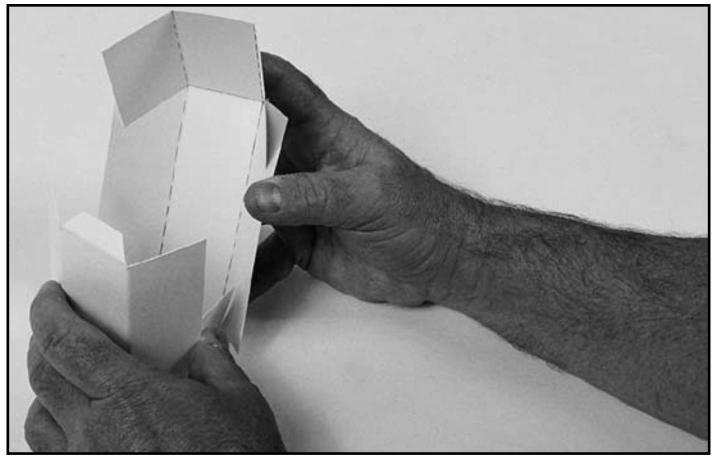


Figure 4.2

By calculating the surface areas, the costs for materials for a box design can be calculated. Many times, designers and engineers will look at several box designs to determine a package solution that will balance the looks, protective aspects, size, and cost. Then, they can determine the best design to use.

Volume

In many instances, the volume of the box is a consideration as well. Volume is an indicator of how much the box can hold.

Finding the volume of a simple box is relatively easy. The volume is the length times the width times the height of the box (L x W x H).

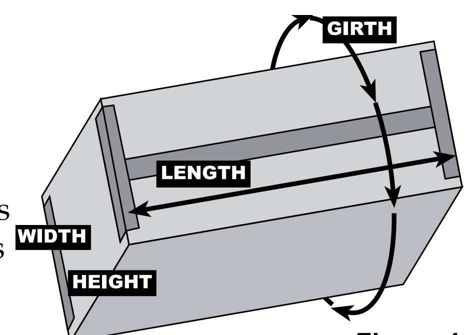


Figure 4.3

Girth

Various shipping companies have limits on the girth of the package they will ship. Girth is the distance around the object perpendicular to the length (assuming the length is the longest dimension of the box like Figure 4.3). The formula for girth is: girth = 2 (W + H).

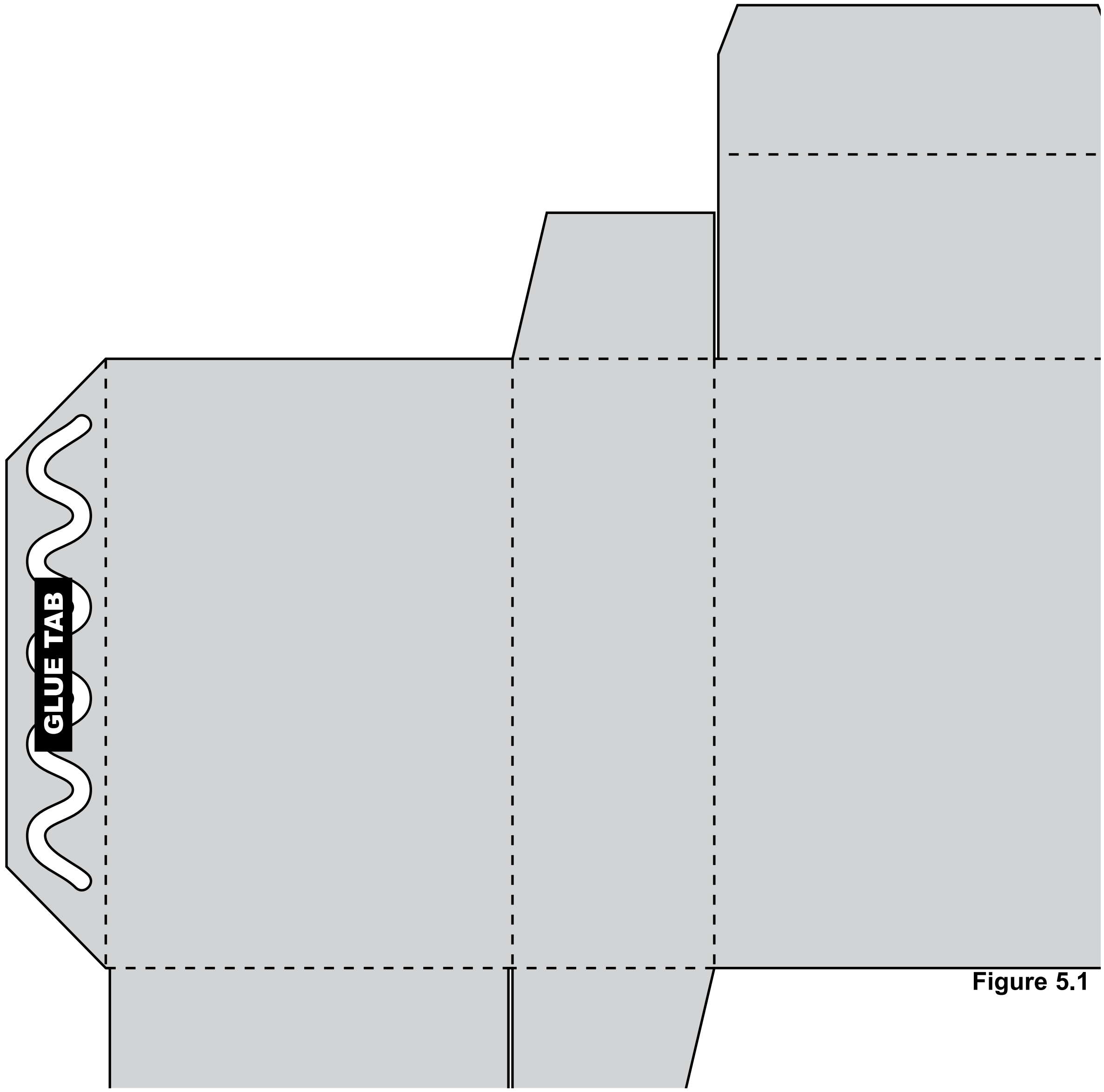


Figure 5.1

Prototyping

After design factors are considered, box designs begin in 2-D (two dimensions) on a piece of paper or computer screen. Box designers must consider how a flat sheet of cardboard can be cut and folded to make a box. They must design in two dimesions to make a 3-D (three-dimensional) box.

A simple box design looks like Figure 5.1 in 2-D.

The solid lines indicate the outline of the pattern. This is where the pattern would be cut from a larger sheet of cardboard. In the manufacturing of boxes, companies use a process called die-cutting to cut out these patterns. This allows automated machinery to produce millions of box patterns efficiently. However, in design and prototyping, manual cutting is done with the use of scissors or sharp knives.

The dashed lines are fold lines. They are where the pattern will be folded to convert the 2-D pattern into a 3-D box. However, before the folds are made, the cardboard must be scored. Scoring compresses the paper fibers to allow the card stock to bend sharply to make a corner. Without scoring, the card stock will not bend in a straight line, and it will make a corner with a radius rather than a sharp corner (Figure 5.2).

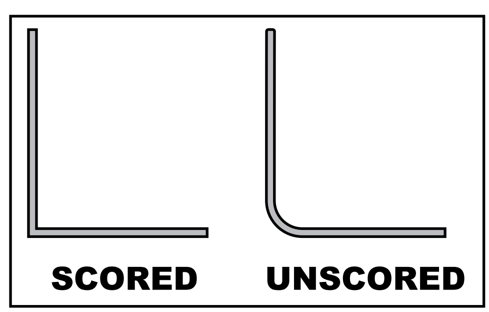


Figure 5.2

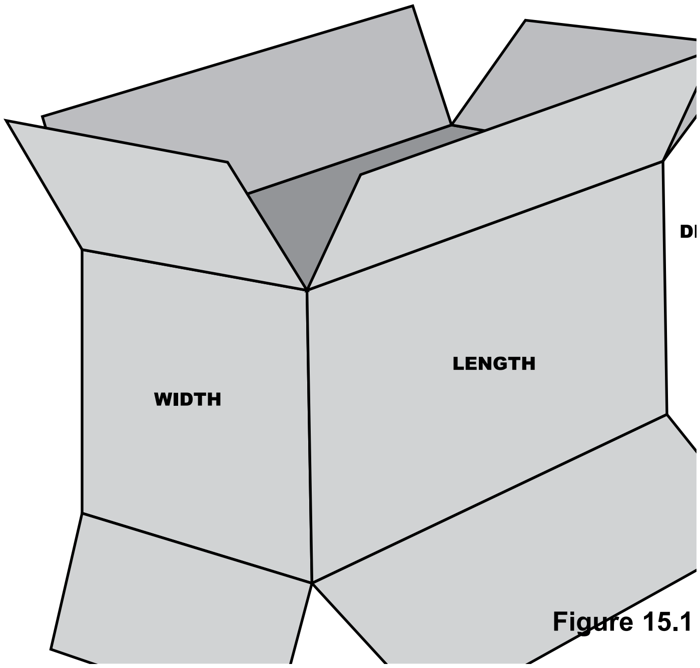


Figure 15.1

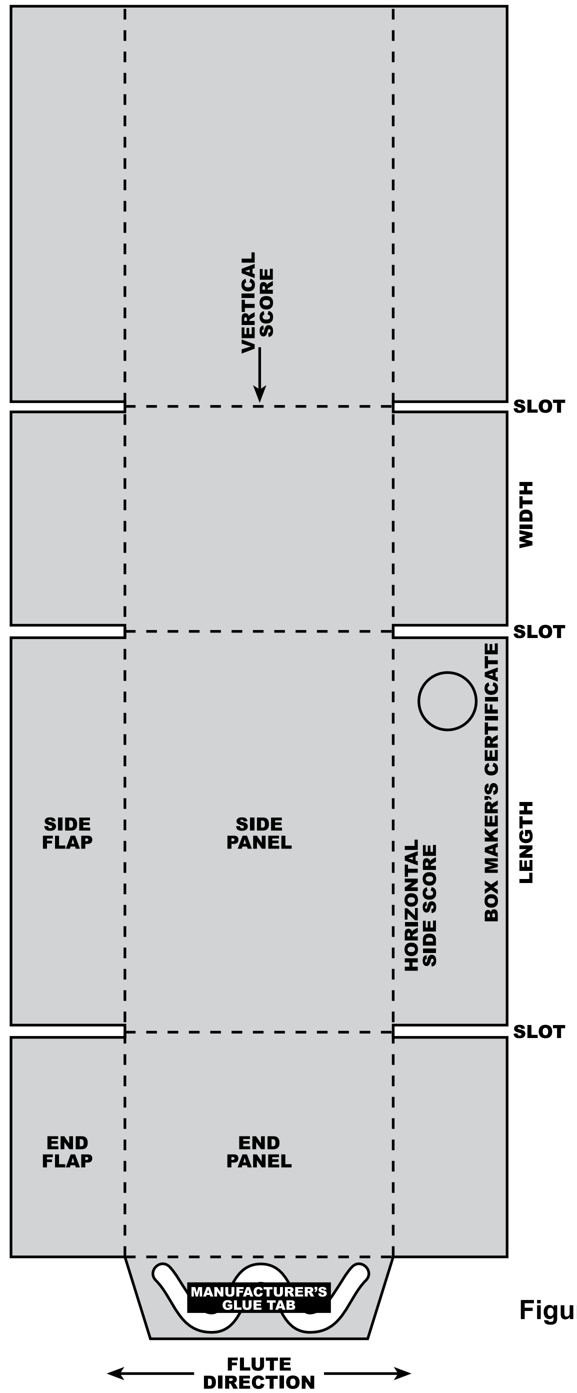


Figure 15.2

Simple Folded Boxes

Most standard shipping boxes are a simple folded box style. While many shipping boxes are made of corrugated cardboard, this simple box style can be made of card stock.

To make a box with the length, width, and depth as shown in Figure 15.1, you can use a pattern similar to the one shown in Figure 15.2.

Using the following formulas, the dimensions of the box will dictate the dimensions of the pattern:

Pattern length (L) is equal to two times the sum of the width (W) and length (l) plus 1/2 inch for a glue flap*.

$$L = 2 \times (W + l) + 1/2$$

Pattern Width (W) is equal to two times the depth (D) of the box.

$$W = 2 \times D$$

Side and end flaps width (FW) is equal to one-half of the depth (D).

$$FW = D/2$$

* On small card stock boxes, a 1/2" glue tab is sufficient. On larger boxes, a larger glue tab may be required.

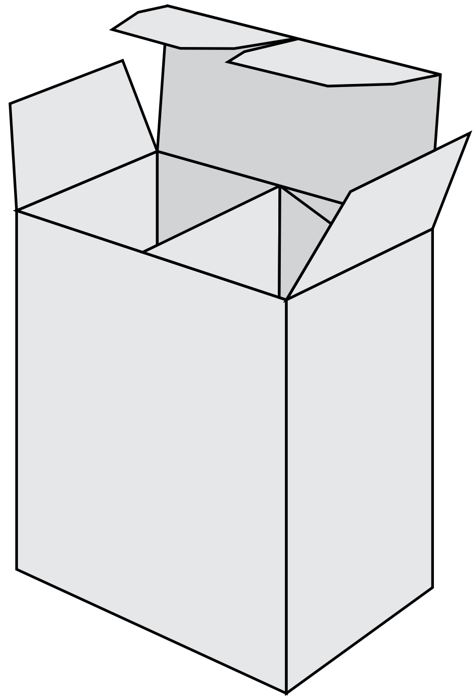
Making a Simple Folded Box

1. Make a simple folded box that is 2" wide, 3" long, and 1" deep.
2. Determine the length of the card stock you need to make the box. The length of the card stock will be twice the sum of the width and length of the box, plus 1/2" for the glue tab.

$$L = 2 \times (W + l) + 1/2$$
$$L = 2 \times (2 + 3) + 1/2$$
$$L = 2 \times 5 + 1/2$$
$$L = 10 + 1/2$$
$$L = 10\ 1/2''$$

Tuck Box with Two Compartments

This is a form of a tuck top box, but with two interior compartments.



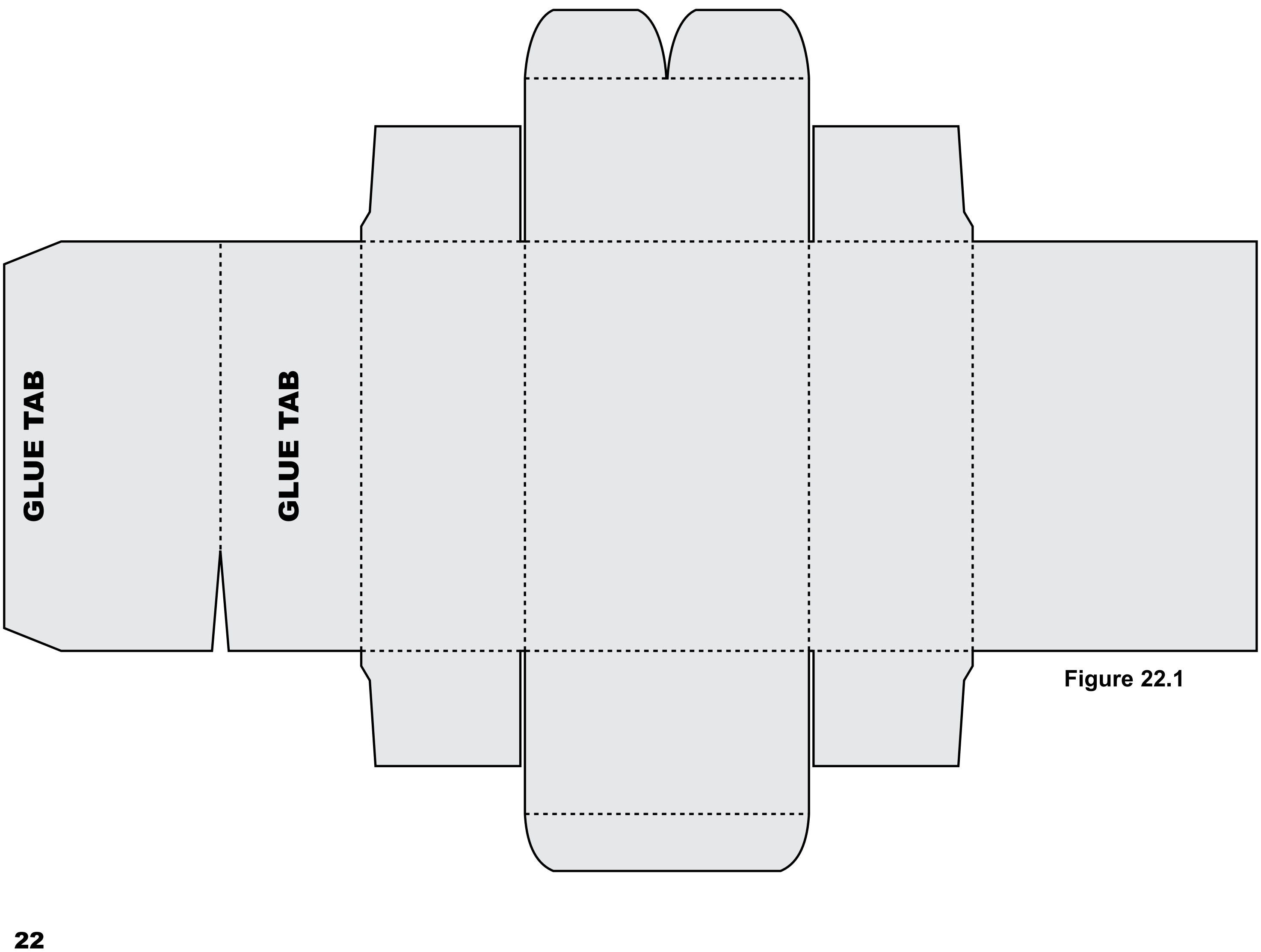


Figure 22.1