4.510 Digital Design Fabrication
Fall 2008

Assignment 2

Sept 15, 2008

Design and Fabrication of a plywood shoe box
Prof. Larry Sass

This assignment is due in class and posted on Stellar, Monday, Sept 29, 2PM

There are two stages in manufacturing this box, first is rapid prototyping followed by CNC. The goal of this assignment is a demonstration of a "prototype to production process". Each student is expected to build their own box complete with your own geometric symbol engraved or cut through selected sides.

Activities

Although prototypical models are not shown here you are expected to do the following:

    a) Design 4 boxes and fabricate with the laser cutter, photograph each model
             Prototypes are ¼ full scale (1/8" plywood or masonite sheets)

    b) Select on prototype to cut for the final

    c) You are only allowed "one" 16" x 32" board, you may want to stain it before cutting

    d) Grading for this assignment is on assembly and visual appeal

1.0   Design Modeling

Start with a box in your favorite solid modeling program. The box should be no larger than 12″ square/the parts should fit within on sheet. I recommend using the example in this tutorial. Consider materializing the design with the methods outlined in the lecture notes and in this tutorial.

Modeling Rules
        1) Always model designs as solid forms at full scale.
        2) This model can include symbolic information such as ornamental design
        3) Priority in a design model is shape and appearance and shape relationship
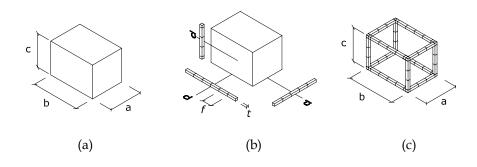

| (a) | (b) | (c) |

Figure 1, a design model and assembly tabs

2.0   Construction Modeling
A construction model is a three dimensional description a design inclusive of all components. Most important is that construction model represents an artifacts construct as well as its appearance. Components are oriented as they would be in the artifacts final assembly.

Fabrication
        Material: Plywood – 1/2″ (13/32 - 15/32″) thick 24″ x 24″
        Assemblies: Embedded – finger joints @ x spacing
        Tool: CNC router

Modeling Procedure
        1) The process starts by explosion of the initial design shape into faces (fig. 1a) this is further subdivided into constructible surfaces based on a relationship between surfaces.

        2) Build geometry for tabs to be attached to the edges of each surface (figure 1). They are built such that the edge of each represents the material thickness (t) the length is divided by the number of joints needed for each side. The more joints the harder the assembly, fewer joints will yield a week assembly.

        3) A critical and complex modeling operation is component attachment to tabs. The goal of this section is to build components with integrated assemblies.
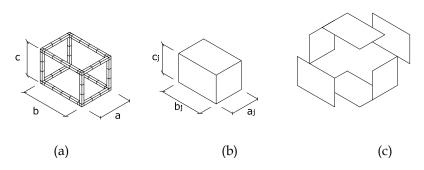
(a)   (b)   (c)

Figure 2, tabs and component modeling.

4) Figure 2a illustrates a collection of tabs for all edges and end conditions. Figure 2b illustrates a smaller box with material removed from each side to accommodate for tab thickness. Figure 2c illustrates component model as a surface. Figure 3a illustrates all components with a given material thickness (t).

5) Figure 3b is placement of the thickened material with the tabs and followed by tab and component grouping Figure 3c (union).

6) After parts have been grouped to include attachment (figure 4 & 5) features last step (figure 6) is copy of component faces to a flatten position.
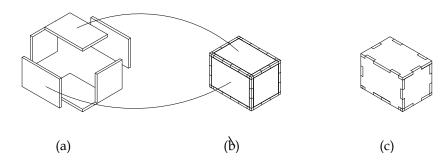

(a)   (b)   (c)
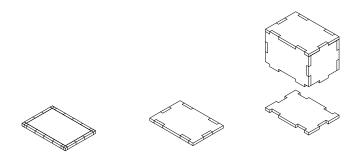
Figure 3, tabs and component modeling.

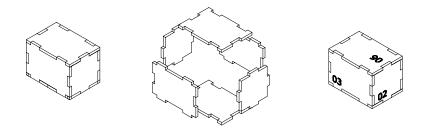Figure 4, joining between component and attachment tabs
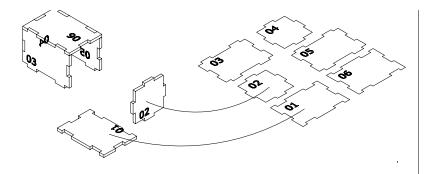
Figure 5, component numbering

Figure 6 copy of faces to a flatten position

3.0   Cut Sheet

A construction model is a three dimensional description of all components oriented as it would be in final assembly. Cut sheets represent the artifact oriented for tool cutting and tool processing.

Fabrication
     Material: Plywood – 1/2″ thick 16″ x 32″ (YOU SHOULD MEASURE THE BOARD FIRST)
     Spacing :   ½″ min.
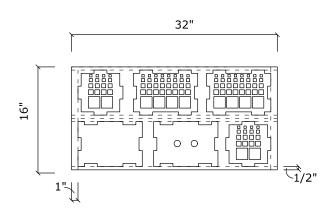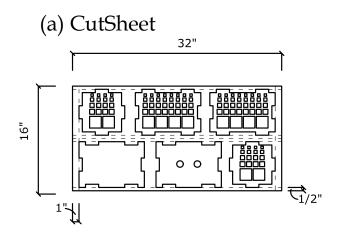   Tool: 1/8″ fluted bit

Figure 7 Setup drawing

Drawing Procedure
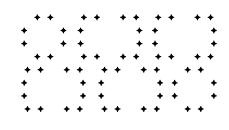   1) After components are arranged in a flatten position they must be arranged within the boundary of the material.

     2) Create three drawing file types

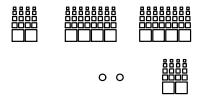   a) CutSheet (figure 7)
          b) Mill – Cutting drawing
          c) Pocket – Internal cuts
          d) Drill – internal edges.

(a) CutSheet
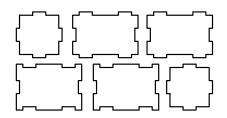
32"

16"

1"

1/2"

(b) Drill
3.5 minutes

(c) Pocket
14 minutes

(d) Mill
10 minutes

4.0   Grading

Gradings best of 100 points of the following breakdown

1. Quality of Structure & Assembly   30%
2. Visual appeal   15%
3. Purpose (Should be a box)   15%
4. Fabrication efficiency (waste)   20%
5. Presentation   20%

- Use MS Word for formatting
- 1 - Photo of final product
- 1 - 3D view of design model
- 1 – 2d View of Cut files

5.0   TURNING IN PROCEDURE FOR STELLAR

UPLOAD: **PDF**
                 (By 2PM)
                 *** – 5 Points for Lateness
                 a.   Name, Date, Assignment #
                 b.   Image of Design Model (Axonometric View)
                 c.   Image of Construction Model (Axonometric View)
                 d.   Digital Photo of final figure
                 e.   3 Page max

IN CLASS: Paper Copy
                         Page 1 - Intro and Prototypes (4 min)
                         Page 2 - CAD model or Drawing
                         Page 3 - Photos of Box

MODEL: On metal shelf in Fab Lab