4.510 Digital Design Fabrication
Fall 2008

Assignment 3

Sept 28, 2008

Design and Fabrication of a Plywood Chair
Prof. Larry Sass

This assignment is due in class and posted on Stellar, Monday, October 21 2PM

Figure 1. Prototyping & redesign of a chair designed by Noel Davis (left) at TU Delft, Holland

Courtesy of Noel Davis. Used with permission.

1.0 Design Problem

Now that you have experienced prototyping in class it is time to redesign and fabricate a new chair for posting and publishing on the web. Your group is required to redesign the "Noel Davis" chair, improve upon its looks, function or structure in order to fabricate a completely new chair from one sheet of 4' x 8' x ½" (remember it is not a true ½") plywood. The new chair should be a work of art in appearance and function. In essence it should follow the Vitruvian design concepts of "strength, utility and aesthetic effect", later translated to "firmness, commodity and delight" by Sir Henry Wotton (1568-1639). The challenge is tougher than most think, today there are many chairs on the market, exciting, fun to sit in and see. There are few chairs that look, feel and function well at a low price point. Here is your chance to change the world of chair design. Try to re-design the existng chair or design a new chair with a specific use. Your chair should strive to be high end.

Assignment Criteria

- Product A chair (not a sofa)
- Material Baltic birch plywood
- Assembly Friction fit (no screws or secondary attachments)
- Tool CNC router

1.0 Items included in this assignment

AutoCAD DWG: A chair designed by Noel Davis – See thesis on Dspace.mit.edu

PDF: On making chairs comfortable: How to fit the seat to the sitter, Alan Marks, Fine Woodworking #31, Nov '81

PDF: On designing chairs: how to develope ideas into woodworking drawings, Alan Marks, Fine Woodworking

2.0 Recommended Schedule

September 28	Assignment Posted/Cut a Demo Chair on the router – see enclosed files Read the articles
October 6	In class design discussion/ Design or redesign chair in CAD
October 13	Build Prototypes/Prep for CNC
October 21	Turnin

3.0 Engineering the Design

There are three basic areas to study, (1) appearance or shape, (2) structural makeup as components, (3) and assembly.

3.1 Design for Shape& Chair Function

First, build a design prototype of your new proposal as a solid model in CAD (Rhino, AutoCAD, etc) then on the rapid prototyping machine. One chair does not fit all be sure to define the audience, range of users and purposes. For example, A child's high chair. Remember you must design for fabrication as well- you are provided only one board of plywood and it is flat (hard to bend into curves).

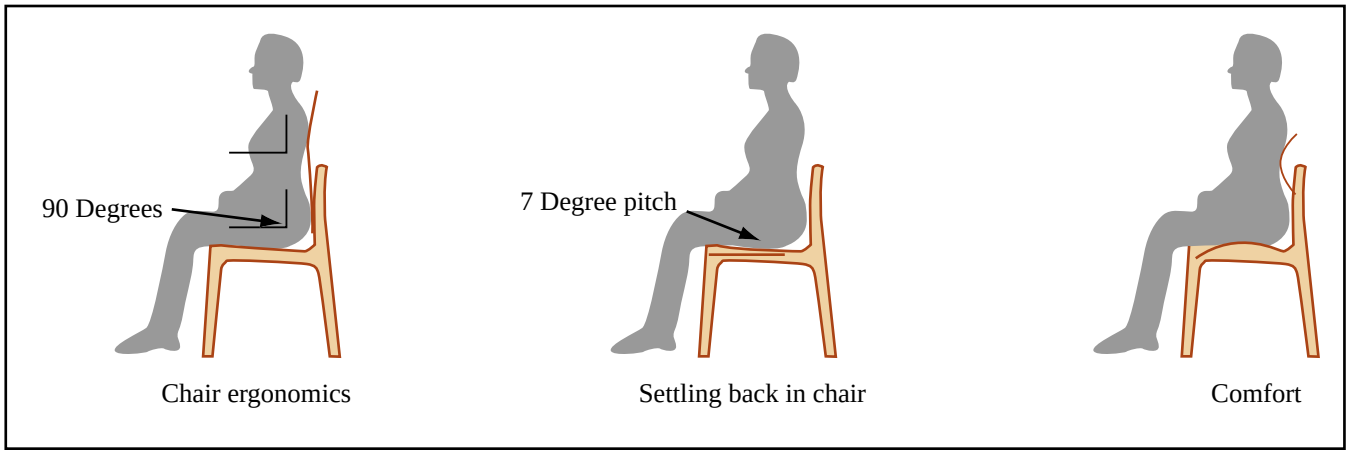


Figure by MIT OpenCourseWare.

3.2 *Design for Structure*

A highly complex function in the design process will be balancing structure and shape. Some chairs are similar in structure to a post and beam building systems. Here posts (the legs) can be 1" in width (*p*), default material thickness is ½"(*t*) and spacing between components can be 2" or less (*k*). An important design challenge is to design the chair for serious loading and random deflection always keeping in mind that only 3 legs are on the ground at any given time.

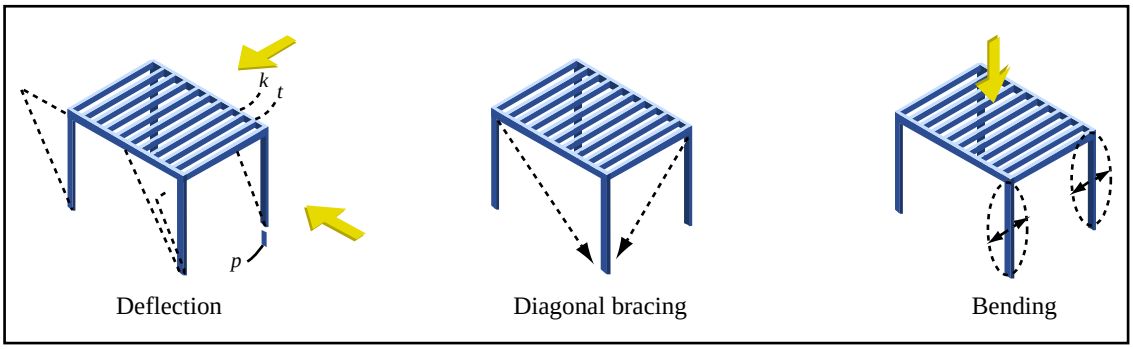


Figure by MIT OpenCourseWare.

3.3 *Design for Assembly*

Last, integrate joining techniques between components into the structure and shape. Joining and assembly should not be considered the last step in design, it is as important as the shape. Four joining methods are offered below they should serve as a starting point or design your own signature joinery if necessary.

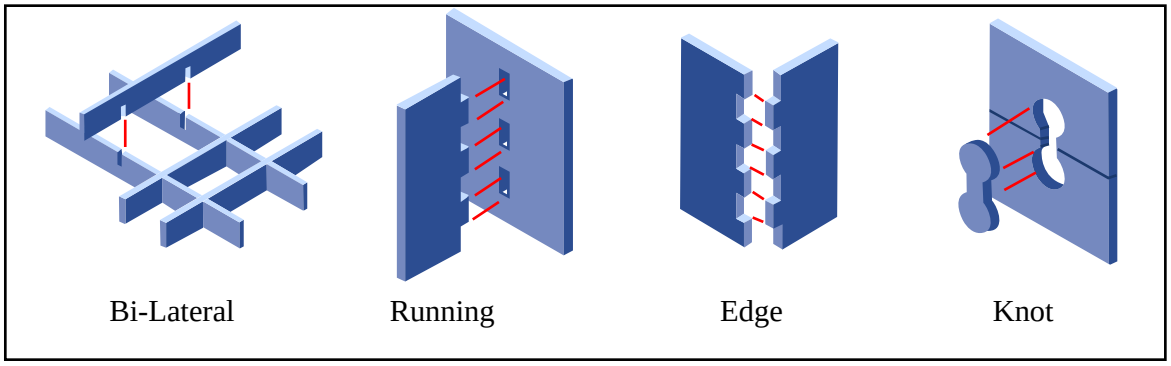
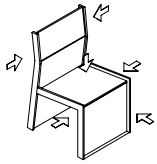


Figure by MIT OpenCourseWare.

4.0 Model Organization and Fabrication

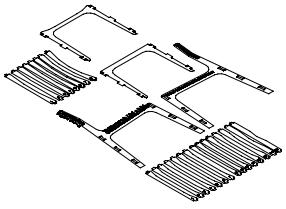
The best designs are based on choices offered the designer and user, thus great designs are an amalgamation of best choices and real world testing. In order to generate and test many good and bad concepts, physical prototyping becomes a critical component in the workflow. Organization of the model and modeling techniques can make for a fast and efficient design production system that allows the designer to generate design variations. Results of an efficient process are physical models with a lot of variation between each scheme. Rule of thumb is one new design per day. Below is a fundamental workflow for digital fabrication use it to guide you through the design and fabrication of your chair.

a) Design Model – Build solid shapes do not worry about materials here, focus on chair appearance, style and functions. Build the chair at full scale in CAD (1' = 1'-0"). You may want to build more than one model and discuss them within your group. A model should not take more than 1 hour to generate.

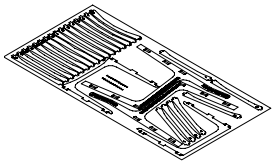


b) Material and Structure Model – Translate solid geometries to surfaces of ½" thickness, find solid areas while questioning structure. At this stage a prototype model is best, cut on the laser cutter of 1/8" plywood then glue at the assemblies. Do not fear redesign at this stage, outcomes of the first prototype may not be as expected.

c) Construction Model – Reduce surfaces to efficient components with butted connection points. Next, assign predetermined joineries to abutting components or create new joineries as needed



d) Cut Sheet – Translate 3d components to 2d positions and number accordingly. It is also possible to label each component with symbols. Numbers must be geometric not typical CAD numbering (explanation in class).



e) CNC design – Optimize part organization within a 4' x 5' sheet of plywood. Make sure that all geometries are closed paths.

4.0 In Class Presentation

Bring the chair to class on November 22 grading is based on the follow:

1. Structure 15%
2. Assembly 15%
3. Visual appeal 20%
4. Fabrication efficiency 20%
5. Comfort 20%

Present the process with no more than 10 power-point slides

5.0 TURNING IN PROCEDURE FOR STELLAR

UPLOAD: PDF
October 21 @ 2PM

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. 10 Page max

CLASS TURN IN: Printout PDF – turn in at the end of class

PLACE: Around the Dome