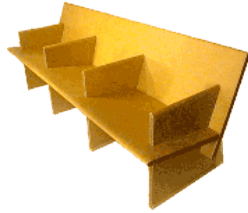


## EDSGN100.011 - Introduction to Engineering Design

Spring 2010

### Project 1: Cardboard Chair Design and Construction



#### Objectives:

This project provides an opportunity to apply the first key steps in the engineering design process (concept to first prototype) as teams design and build a functional chair.....with unique constraints!

The chair design must be:

1. Stowable under a bed - - meaning it can be disassembled into pieces that all fit in a 12" vertical space.
2. Load bearing per design needs. The half-scale chair must support at least 80 pounds.
3. Built of only two materials: corrugated cardboard and water-based glue. No added materials can be used that would make the chair non-recyclable.

Additional guidelines include:

- Ergonomically appropriate
- Aesthetically pleasing
- Safe (does not wobble, teeter, or collapse in catastrophic ways)

#### Motivation:

Engineers have the potential to design wonderful, innovative products that meet all of the needs of the users and do no harm to the larger community of life, both now and in the future. In fact, we are starting to envision ways of providing for the needs of present generations while improving the state of the world. These ideas are reflections of the concept of sustainability, meeting the needs of the present without diminishing the ability of future generations to meet their needs.

Engineering activities can be unsustainable in several ways. They can use up valuable resources that are nonrenewable. They can produce byproducts that are harmful to life. They can further societal inequities. In the course of this project, you'll learn some of the ways that engineers can account for these factors. You should also feel some satisfaction in creating a piece of furniture that is both useful and attractive for someone living in a home such as the Solar Decathlon home. Sustainability is important, but function and beauty are also necessary for a successful design.

This experience should also improve skills associated with working in teams and familiarize you with the engineering product development process and program management tools. You will also have an opportunity to put some of your newly developed CAD skills to use.

#### Outline:

To accomplish this project tasks will include:

1. Clearly define the problem or need
2. Survey students potential buyers or users (develop the survey, poll students, analyze data) on what type of furniture is needed or could be of interest

3. Do research on product design, ergonomics, aesthetics, and construction
4. Develop several ideas for product design and document with sketches
5. Narrow down design options
6. Develop product selection criteria and analyze survey results
7. Do detailed design and weight-bearing analysis
8. Develop detailed drawings
9. Produce scale models using manila folder paper or poster board
10. Evaluate and modify as needed
11. Participate in producing a half-scale prototype
12. Develop web-based report
13. Reflect on process

**Steps for this project:**

**Week 1 (Design Lab - Friday Jan. 15):**

**Woodshop Safety Review and Orientation**

**Activity #1:**

Design for X - Manila Folder Bridges. Students formed into groups of 4. Each student gets one manila folder. Instructor assigns task to design/build a bridge using different “Design for X” feature sets. Goal: see that there are many valid designs for any given design problem. Which is best requires more analysis and judgment. Investigate how to make 2-D material into strong 3-D shapes.

**Week 2 (Design Lab – Friday Jan. 22): Cardboard Furniture Project (CFP) Kickoff**

- Bring Design for X bridges to class; discuss results in the teams
- Review requirements for CFP project.
- Start developing idea for the cardboard furniture chair/seat.
  - *Stage I (n=1):* Each student individually generates a set of possible ideas or features for a structure to provide seating. Any idea is a good idea...take notes also about special features. Identify this set of ideas as the first stage, called Stage I (n=1), where n = number of people involved in creating ideas. Write down all your ideas!
  - *Stage II, (n=4 or 5):* students work in their teams. Pool the design ideas to create a (hopefully) longer dorm furniture list and kid’s furniture list. These are called the Stage II (n=4) lists. Add to the list if new ideas are generated as a group.

n is the number of people that are surveyed. It is the independent variable.
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**Before Class on Friday Jan. 29:**

**Task 1: Gather more chair ideas....**

Each student asks four people for their chair/seat ideas they would like to have or think would sell; KEEP A LIST! Asking different people for their furniture design ideas is very effective (male, female, different majors, ages, from different hometowns/countries). We will collect all ideas in class Friday to get full count.

**Task 2: start making ideas reality....**

Look at the on-line resources about cardboard furniture products, designs, examples. Each student makes a well-constructed scale model of chair/seat using manila folder. Use scale of 2” model = 1’ real chair/seat. These models will be shown to your team mates to help define the team’s chair/seat design in class on Jan. 29.

### Week 3 – (Design Lab Friday Jan. 29):

**Task 1:** Collect all survey results for all team mates. If each person did three surveys, the team should have 12 responses. Compile and discuss the results.

**Task 2:**

- Look at team member's scale models; take pictures!
- Discuss design ideas, construction techniques that work and don't work.
- Do additional research on product design and construction, as needed.
- Based on the survey results, scale models, and research, develop **product selection criteria**: what are 5-6 design features the team wants to focus on. Suggestion: look at the Objectives listed on Page 1.
- Based on new ideas and chair models, develop more specific ideas for the chair/seat design. Do preliminary development of at least 3 different concepts and **document with sketches**.

**Task 3:** Strength of materials - session #1

In class, teams will construct specific cardboard structural segments in various shapes that will be crush-tested next week. These experiments will help answer questions such as "What method of layering or bending corrugated cardboard provides best strength for least amount of material?"

### Week 4 – (Design Lab Friday Feb. 5):

**Task 1:** Crush testing

**Task 2:** Design selection: each team provides detailed sketches and/or CAD designs of their chair design showing key design features and dimensions. Teams provide estimate of amount of material needed. Begin prototype construction and define what work the team members will do.

### Week 5 (Design Lab Friday Feb 12):

**Task 1:** Strength of materials - session #2: Design and build any new structural elements that team is interested in. Test cardboard structures, interpret results.

**Task 2:** Cardboard Chair construction day...build it!

**Task 3:** Collect information on bulk corrugated cardboard and glue costs. Work on costing (information will be provided)

### Week 6 (Design Lab Friday Feb. 19):

**Task 1:** Cardboard Chair construction day...do it! Also, do more crush testing, as needed.

**Task 2:** Start work on CFP web report (outline will be provided).

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**Task 3:** Discuss how your team is going to present your design solution to the class on Feb. 26. Slide presentation, simple verbal description, "info-mercial" skit are all acceptable. Presentation requirements:

- demonstrate a user can assemble and disassemble the chair
- demonstrate the chair can hold 80 pounds
- show the value and unique feature of the chair

**Task 4: Write the Product Positioning Statement** – use template below:

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**Product Positioning Statement: Cardboard Furniture Design Project**

**Team Name:** \_\_\_\_\_ **Team #:** \_\_\_\_

**Product Name:** \_\_\_\_\_

**Product Positioning Statement:**

Sentence #1: **For** (*target customer*) **who** (*statement of need or opportunity*), **the** (*product name*) **is a** (*product category*) **that** (*statement of benefit*).

Sentence #2: **Unlike** (*primary competitive alternative*), **our product** (*statement of primary differentiation*.)

**Key design features:** *List the big selling points on your design!*

**Goals in the Design:** *Low cost? Easy to use? Safety? Greenness? Effectiveness? Durability?*

**Estimated selling price for the (Product Name):** \$\_\_\_\_\_ ....and describe how you came up with this price estimate.

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**Week 7 (Design Lab Friday Feb. 26):**

- First 10 minutes of class: final chair/seat construction work, practice presentation “pitch”.
- 80 minutes: **In-class demonstrations of final furniture design.**
- End of class: reflection/discussion on CFP