Tufts UNIVERSITY | Center for Engineering Education and Outreach

EQUIPMENT INTRODUCTION PROJECT

2D DESIGN AND LASER CUTTING

PROJECT DESCRIPTION

Participants create a laser cut structure by first prototyping the structure in cardboard then with the laser cutter.

LEARNING OBJECTIVES

Teamwork: participants must work effectively in groups to create a structure.

Process: this project helps participants to understand prototyping and the iterative design process.

Fabrication: participants learn about laser cutting as a method of fabrication.

Design: this project introduces how to create 3D structures from a 2D fabrication process.

Architecture: participants explore a field which combines art, science and mathematics.

BACKGROUND

Architects use small scale prototypes during their design process and to explain their ideas to land owners, investors, and others. Participants will create their own architectural designs and models in this project.

This project helps participants to learn how to design three dimensional objects with two dimensional fabrication methods. This is done by first creating a prototype with cardboard. Then using that cardboard model as a reference to create a 2D digital drawing of the structure. These drawings are used to fabricate the design on a laser cutter.

SOFTWARE

Any vector drawing software may be used for this project. For example:

Inkscape | INKSCAPE tutorials

A free software program for designing vector graphics

EXAMPLE SESSION: 60 MINUTES + LASER CUT TIME

Introduction: 10 minutes

Explain to the participants that they will be working in groups to create a structure. Participants will use the design process to create the structure out of cardboard. This will be their first prototype. Then they will iterate on their design and construct the next prototype from a laser cut material (such as wood or plastic).

It is recommended that participants are given a site or purpose for their structure to help focus ideas. For example, a new pavilion for a school or city center.

Show examples of cardboard and laser cut structures and explain the laser cutting process.

It is recommended to have physical examples for participants to examine the size, shape and feel of laser cut and cardboard parts. This will also help when explaining the process and the properties of the laser cut material and cardboard.

Brainstorm, Plan and Create First Prototype: 30 minutes

Have groups start brainstorming, planning and creating their cardboard prototype.

Reflection: 10 minutes

Have groups share their designs and how they could improve the design for their second (laser cut) prototype.

Introduce the 2D Design Software: 10 minutes

Spend some time introducing the 2D design software. For example, show how to:

- Create, move, and rotate shapes and lines
- Copy and paste objects
- Combine and subtract objects

2D Design & Fabrication: varies depending on the number of participants

Have groups create their 2D designs, laser cut their parts then assemble their second prototype.

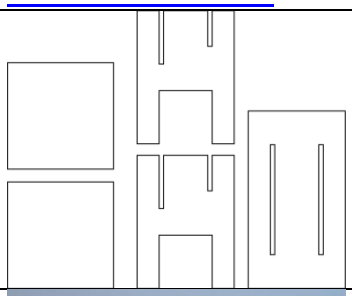
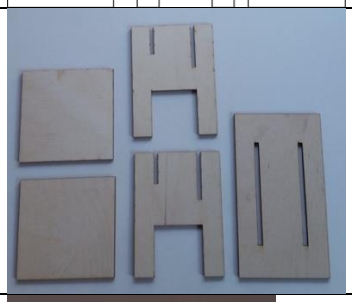
Second Reflection: 10 minutes

Have groups share their final prototypes and reflect on how they would improve their design and design process if they were to do this project again.

POSSIBLE MODIFICATIONS AND EXTENSIONS

This project could be extended by having participants each create a structure in a city. Then use equipment such as Arduino, 3D printer, and robotics to construct electrical and/or mechanical systems for the city.

EXAMPLE PROJECT

First Prototype: Cardboard	
2D Design	
Laser Cut Parts	
Second Prototype: Laser Cut Wood	
Reflection	In moving from the first to second prototype, there were two issues. Since cardboard is a more flexible material, it was discovered that the tolerances did not have to be as accurate as the wood prototype. Below are suggested improvements to fix these issues if this project was done again. 1. In the second prototype, the roof could not be moved into a slanted position. To fix this issue, the roof slots should be made larger to allow for more flexible positioning. 2. It was also difficult to get the slots the correct dimensions for press fitting into place (to have the structure stay together without glue). The slots in the second prototype were too large therefore the structure needed to be glued in order to stay together. More investigation into the correct tolerances for press fitting this wood into place should have been done.