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2.00AJ / 16.00AJ Exploring Sea, Space, & Earth: Fundamentals of Engineering Design
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2.00AJ Fundamentals of Engineering Design:

Explore Space, Sea and Earth

Lab Session #1: An Introduction to the Machines in the Lab

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1. Introduction

This document provides instructions for manufacturing a floatation device from PVC pipe. Students are provided an opportunity to gain hands-on experience in using machinery in the lab while constructing these devices that can be used for their projects later in the semester.

2. Objective

The aim of this exercise is to introduce students to the lab machinery that will be utilized extensively throughout the construction phase of the semester project. An equally important outcome is to teach students the inherent dangers and safety issues that accompany working in a lab with rotating and cutting machinery.

3. Floatation Device (Buoy)

The floatation device will consist of a section of PVC pipe (8" in length) that is enclosed with a PVC cap at each end. See Fig. 1.



Figure 1: Floatation device constructed from PVC pipe [1]

Courtesy of Alan R. Applegate. Used with permission.

A hole will be drilled in each end cap to insert an eye hook for attaching the buoy to other structures. The eye hook will then be secured with a set of hex bolts. The entire assembly will be sealed with silicon at a later stage. Fig. 2 shows the eye hook and nut.

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Please see http://www.fdsions.com/images/national/eye_bolt_hex_nut_n221-085.jpg

Figure 2: Eye hook with hex nut [2]

4. Components

The following components will be used to build the buoy:

- 1 x 3" dia PVC pipe cut to a length of 8"
- 2 x 3" PVC end caps
- 2 x 3/8"-16 Thread Eyehooks
- 4 x 3/8"-16 Thread Size Hex Nuts

5. Machines

You will use the band saw (Fig. 3) to cut the PVC pipe to length and the drill press to drill the holes in the end caps where you will insert the eye hooks (Fig. 4). The course's TAs will demonstrate the proper, safe use of the machines.

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Please see <http://www.redmond-machinery.com/images/Delta/Delta%2028-640.gif>

Figure 3: Band Saw for cutting PVC pipe [3]

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Please see <http://www.shopsmith.com/markvsite/images/16.5%20VerticalDrillPressSM.gif>

Figure 4: Drill Press for drilling holes into end caps [4]

6. Procedure

Important Safety Information:

1. Students are required to wear safety glasses at all times when working with the band saw and drill press.
2. Long hair should be fastened to prevent it from getting caught in the rotating machinery.
3. Loose clothing and jewelry should be removed before working with the machines.
4. It is required that all students wear closed toed shoes in the lab. No high heels or flip-flops allowed.

The following steps explain how to construct the buoy:

1. Cut the PVC pipe to a length of 8" using the band saw.
2. Place the PVC end cap on the drill press bench oriented so that the convex section is facing up. The drill bit should be centered above the middle of the cap.
3. Drill a hole through the cap while being careful not to make contact with the drill press bench once the drill breaks through the end cap.
4. Repeat steps 2 and 3 for the other end cap.
5. Fasten one hex nut onto the eye hook so that it is screwed on all the way to the end of the thread.
6. Insert the eye hook into the hole in the end cap from above so that the thread is protruding in the inside of the cap. Use a spanner to fasten the other hex nut thus securing the eye hook to the end cap.
7. Repeat steps 5 and 6 for the other end cap.
8. Press the end caps onto the PVC pipe to end up with the buoy displayed in Fig. 1.

We hope that you have enjoyed the first lab session and that you feel comfortable with using the lab equipment. We trust that you are eager to move on to the actual project.

References

- [1] Applegate, Alan, 2008. Antennas, Home Brew Coils. [Photograph] Available at: <http://www.k0bg.com/homebrew.html> [Accessed 28 January 2009].

- [2] F.D. and Sons Hardware, 2008. Hooks – Eye hooks & Turnbuckles – Eye Bolts. [Photograph] Available at: http://www.fds sons.com/hooks-hooks-turnbuckles-bolts-c-77_112_1534.html?page=3&sort=3d [Accessed 28 January 2009].
- [3] Redmond & Son Inc. Machinery, 2007. Delta 20” Band Saw. [Photograph] Available at: http://www.redmond-machinery.com/delta_28-640.htm [Accessed 28 January 2009].
- [4] Shopsmith Inc., 2008. Shopsmith Mark V Drill Press. [Photograph] Available at: http://www.shopsmith.com/markvsite/ver_drl.htm [Accessed 28 January 2009].