

Cutting, Milling, Drilling, Tapping and Brazing -A “Hands-on” Experience –

**Patricia M. Shamamy, P.E,
Lawrence Technological University**

Abstract

Second semester junior M.E. majors are required to individually design and build a metal object in the university machine shop using the processes of cutting, milling, drilling, tapping and brazing. Additionally, the object built must have one moving part. Creativity is encouraged as the type of object to be designed and built varies each semester. Thus far, types of objects have included animals (wild, domesticated or composite), transport vehicles (to transport people or goods over land or water), people (two figures representing humans involved in some task), and, most recently, models of interplanetary vehicles. M.E. faculty judge the projects and prizes are awarded in different categories, among them, Most Original, Easiest to Manufacture, and Most Potential for Commercial Product.

I. Introduction

Students enrolled in our Mechanical Engineering curriculum are required to complete a senior design project. The project is intended to require the student to apply his/her engineering knowledge to design, build, and test an actual product. These products vary from components for SAE competition projects such as the Formula Car, Mini-Baja vehicle, or Supermileage vehicle to student-proposed projects that have included an adult tandem tricycle, a creep testing apparatus, and a Weed-Whacker supporter.

In each project, students are involved in some aspect of fabrication of a part. Usually these parts are made in the university's machine shop and require the student to use various metal shaping equipment. To introduce the students to the various pieces of equipment available for their use, in the semester preceding the one where their senior projects are begun, students are required to use the equipment in the machine shop to build a small object. This paper describes the project used to introduce the students to the equipment in the university machine shop.

II. Project Description

Each student is required to individually design and then build a metal object. Students may provide their own material or may use whatever is available in the university shop. All fabrication must be done in the university machine shop and must make use of the metal shaping processes of cutting, milling, drilling, tapping and brazing. Additionally, the object must have at least one movable part. The object must have a minimum height(or length) of four inches.

The “type” of object required varies each semester. Thus far, the following categories have been assigned: animals (wild, domesticated, or composite), transport devices(used to transport people or goods over land or water), people involved in some task, and interplanetary vehicles.

Before the building process is begun, the various metal shaping processes are reviewed in class. The time needed to complete the project is discussed. Students are asked to estimate the time needed for each step - - designing, cutting, milling, drilling, tapping and brazing. They are also reminded that time is needed for clean-up.

Students must attend a Safety Orientation before any work can be done in the lab. The projects must be completed within a three-week period. Staff members are always available to instruct and assist the students in the use of the various pieces of shop equipment.

To encourage the students, prizes are awarded to the best projects. Judging is done by the faculty in the Mechanical Engineering Dept. Prizes are awarded in the following categories: Overall Best of Show, Easiest to Manufacture, Best Construction, Most Original, and Most Potential for Commercial Product. The best projects are also displayed in the Engineering Building.

Photographs of the various projects are shown in four Appendices(one page per Appendix) to this paper. The small white label on the front of each project can estimate the size of the object. The label is 0.75-inches wide and 0.50-inches high.

III. Conclusion

This project has been very successful in a number of areas:

- Students learn early through a “hands-on experience” what machine shop equipment will be available for their use during their Senior Project;
- Students are made aware of and are required to use standard machine shop safety practices;
- Students with no previous machine shop experience receive essentially individual instruction on the operation of various shop equipment;
- Students have a chance to use their creativity in designing and building their project.

Additionally, almost all students are very enthusiastic about this project. Many remark that they now have a better understanding what they learned in the Manufacturing Processes course. The caliber of the projects tends to be quite high. The faculty also enjoy being involved in the judging of the projects. Thus the project is a very positive educational experience for our students.

This project is not based on any projects reported in the literature. The project is this author's idea. Although it is quite probable that other universities may have a similar type project, this author is not aware of any that have been reported.

IV. References

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2. DeGarmo, E. Paul, et al, “Materials and Processes in Manufacturing,” Sixth Edition, Macmillan Publishing Company, New York, 1984.
3. Kalpakjian, Serope, “Manufacturing Engineering and Technology,” Third Edition, Addison-Wesley Publishing Company, Reading Massachusetts, 1995.

Biographical Information

PATRICA M SHAMAMY, P.E. is Professor of Mechanical Engineering at Lawrence Technological University in Southfield, Michigan. Besides teaching, she currently does consulting work in materials and manufacturing and also serves on the University E-Learning Committee and the College of Engineering Entrepreneurial Program Planning Committee.

Address: Mechanical Engineering Dept., Lawrence Technological University, 21000 West Ten Mile Road, Southfield, MI 48075; e-mail: shamamy@ltu.edu.

Appendix 1

Photographs of Animal Projects



Unicorn



Wild Giraffe



Feline Rodent



Oscar the Hot Dog



Square Belly Spring Neck



Big T



Golden Plumed Bolt Eater



T-Rex

Appendix 2

Photographs of Transport Vehicles



The Wolf



Dump Truck



Dune Buggy



Red Scooter



Locomotive



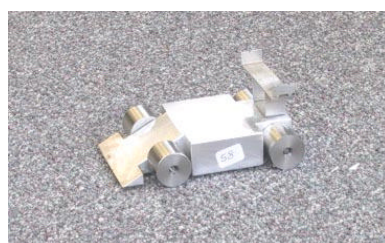
Off-road SUV



Red Wagon



Newt



Silver Bullet



Junior



Fork Lift

Appendix 3

Photographs of People



Boxers



Woodsmen



Square Men



Dueling Duo



Woodcutters



Weightlifters



Copper Men



Oriental Woman

Appendix 4

Interplanetary Vehicles



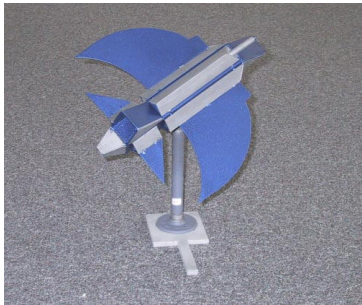
Contact



Glitter Bug



Hover Spacecraft



LTU 1



Martian Transporter



Eagle XR7



U.S.S. Solar Sail



U.S.S. Hub Unit