



Catapulting a Squash Ball

A Design Project for ECE 194: Introduction to Engineering
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Overview: The object of this project is to design, build, and operate a catapult that can launch a squash ball with accuracy and repeatability. The catapult must have a variable range of 10 to 20 feet. The catapult is to be built from a kit of parts (Meccano Set) which are provided to the teams.

Learning Objectives or Student Outcomes:

Students will

1. choose and employ a structured design methodology, such as a functional decomposition approach, a concept combination table, etc.
2. design, build, and operate an engineering artifact under specific constraints.
3. collect data in order to empirically determine the "performance map" of the artifact.
4. demonstrate the operation of the artifact to establish reliability, accuracy and precision.

Length of Lesson:

This project takes place over a period of about six weeks.

Materials Needed:

Catapults are constructed from the parts in a Mecanno Set, which is provided to the students. Teams may supplement the kit with some type of basket to hold the squash ball, and some elastic material or spring of some sort to provide the energy source for the catapult. They may also supplement the kit with some PVC pipe parts and joints to provide more "structural integrity." However, those designs that minimize the use of PVC parts receive higher design scores. The total cost of any additional parts can not exceed \$10.00.

Assignment(s) to Ensure Student Preparation:

As this course is part of an integrated program, the prerequisite content knowledge is being learned in physics (kinematics) and calculus (curves, functions, parabolas). Skills such as problem definition and concept generation are taught and reinforced by a number of short lectures and classroom activities throughout the duration of project. Writing skills are also integrated, in that the teams write memos detailing the process that they go through to arrive at their particular design and to justifying their choices.

Team Size/Composition:

Students are placed in teams of four on the basis of where they live, in order to facilitate their getting together outside of class. Teams stay together for the length of the project.

How is positive interdependence built in to the project?

The project is too complicated and lengthy for any one student to do alone.

Only one project is turned by the team. Students receive a common grade for the project.

How is *individual accountability* built in to the project?

Students learn techniques and are given opportunities for giving each other constructive feedback about their performance as team members.

Peer evaluations are used to adjust the grades of individuals within the teams.

Basis or Components of Assessment:

5. The actual product and its demonstration.
6. A "design notebook," that documents the design process.
7. A succinct report on the final design that also includes the testing and final outcome of the project.
8. An assessment of another team's product using a decision analysis procedure.
9. Peer evaluations of individual performance.

Team Skills Emphasized:

Teams are required to reflect upon and assess their internal processes as an ongoing part of the project.

Handouts, Overheads, Forms, etc:

Materials available to students on the class web page are provided here as pdf files.

1. Description of Project (<http://www.eas.asu.edu/~roedel/ece194f00/projects/project1.html>)
2. Report Format (<http://www.eas.asu.edu/~roedel/ece194f00/projects/report1.html>)
3. Sample Performance Map Graph
(<http://www.eas.asu.edu/~roedel/ece194f00/projects/pdf/catapult.pdf>)
4. Decision Analysis Form for Evaluation of Other Team's Catapult. (?????? – link is broken)
5. Teammates' Salary Allocations
(<http://www.eas.asu.edu/~roedel/ece194f00/projects/salary.html>)