

Problem 4.2.3 Design Problem

Purpose

Have you ever used a slingshot? Have you seen a pumpkin launched from a catapult system or cannon? Using these devices can be fun, but what is the success rate for hitting a target? If the target is large enough, contact becomes simple. However, what if you want to be precise? What if you wish to hit a target at a given distance?

Design challenges provide opportunities to apply skills and knowledge in unique and creative ways. Designers are often asked to come up with solutions to problems.

Designers sometimes work together as a team and must collaborate to create a solution. They must communicate with each other. Every member of the team must contribute if the team is to be successful. Now it is your turn to be part of a design team.

Equipment

* Instructor-designated building materials
* Engineering notebook
* Isometric grid paper
* Orthographic grid paper
* Computer

Procedure

To solve this problem, your team of two to three must innovate to make improvements to a design demonstrated by your instructor. Your team will design a solution to the stated problem. Study the design brief located on the following page. Using the steps in the design process, your team will create a solution to the design problem.

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| Client Company: | Hobby Spectacle, Inc. |
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| Target Consumer: | Society |
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| Designer: |  |
|  |  |
| Problem Statement: | A leading hobby company is looking to improve an existing launcher design. The device must launch a projectile using the materials provided. The device must be adjustable so that projectile launches can be precise at varying distances. The winning design will receive cash for a patent that can be mass-produced as a kit and sold to the public. Members from the company will be present during the launching phase of the process. |
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| Design Statement: | Improve an existing design, then build and test a device that will launch a projectile varying distances with precision and accuracy.  |
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| Constraints: | 1. Must be constructed using the materials outlined by the instructor.
2. Must be adjustable to different angles including: 10, 20, 30, 40, 45, 50, 60, 70, 80 degrees.
3. Must have the same initial velocity at any adjusted angle.
4. Must launch a projectile at least 15 ft.
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Deliverables:

1. **Title Page:** This will include the title of the problem, names of team members, course title, school name, and date.
2. **Table of Contents:** Include all major headings below, in addition to any other major sections that are necessary.
3. **Brainstorming Ideas:** Provide a listing of at least four of your team’s brainstorming ideas for the design solution. This should include brainstorming sketches or 3D modeling of your ideas.
4. **Decision Matrix:** The team will plug their four solution ideas into the matrix to determine the best solution to the problem.
5. **Final Design Solution:** Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon your team’s decision matrix. Your sketch or 3D model should include a rationale for the design selected as the final design solution.
6. **Design Modifications:** If you change your final design solution, simply document the modifications. Explain the issue causing the need for the modifications and describe how the new design solution will solve the problem (refer to **Design Modifications Chart**).
7. **Final Design:** This section will include information pertinent to the design solution in the form of images (e.g., photographs of final solution, photographs of testing solution, orthographic and isometric drawings, assembly, schematics, exploded views, written programs, flow charts, calculations, and data tables).
8. **Reflection:** How well did you accomplish your objectives? What would your team do differently with your design solution and why? How did your design solution compare to the other teams’ solutions? Do the results fulfill the problem statement? Provide a brief explanation of what you learned, the challenges of working in a design team, and the purpose of the design problem.
9. **References:** Using APA format, cite all sources used to obtain information pertaining to your design problem (e.g., books, magazines, journals, Internet sources, etc.). Refer to **Citations in APA Style**.
10. **Career Connections:** Refer to **Career Connections** document for detailed information.

Conclusion Questions

1. What was the most challenging aspect of this design problem?
2. What are some creative changes that you would make to the design solution if you could start over?
3. Suppose that the client wants your ballistic launcher to be guaranteed to hit a target at least once, given three tries.
	1. Would a 34% success rate per launch be good enough? Explain why or why not.
	2. If a launcher hits the target 34% of the time, what is the probability that it will miss three out of three tries?
	3. *Enrichment:* If the client defines a “success” as hitting the target at least once, given three shots, what success rate *per launch* is necessary to succeed 99 times in 100 groups of three shots? Explain your reasoning.