



EDSGN100
Project #2
Final Design Report

Sports Drink Launcher – Projectile
Section 205
Professor Thomas Colledge

Team 6

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Executive Summary:

After being assigned by Professor Colledge, our group sought out to design a projectile that would be able to carry 100 milliliters of sports drink to fans at events in sports arenas, namely Penn State's Bryce Jordan Center. Our team recognized the opportunity to profit off of the ability to market drink companies' product on our projectile. Based on the launching team's design, we determined that the best plan for our device was to create a rocket-esque projectile out of light, thin plastic. The rocket would open in the center around the circumference, holding two separate 50 ml drinks. Once the device would reach the apogee of its flight, it would fall bottom first and would be slowed to a safe, catchable speed by a hexagonal parachute. To ensure that the rocket can be reused, fans could be given a discount at the concessions stand for returning the device.

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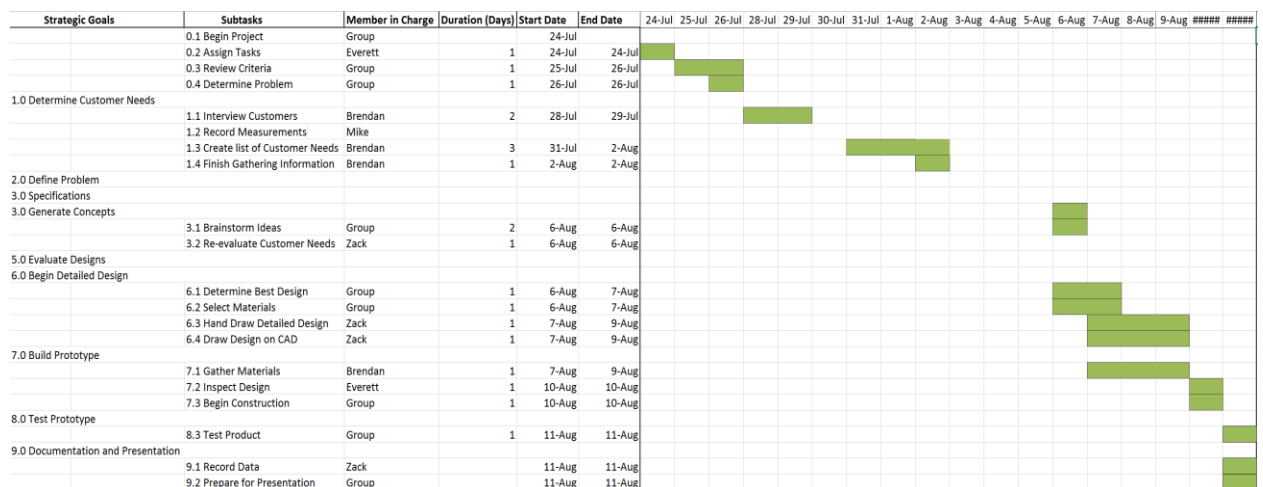
1.0 Introduction

We were assigned to the task of determining a way to deliver 100 milliliters of a drink sample to fans at Penn State's Bryce Jordan Center from a launch platform. The Bryce Jordan Center seats 15,261 people, making this device an ideal way to market drink products to fans in a new, fun way. In addition to coming up with a design, we had to keep an eye on other criteria, such as the needs of our customers and stakeholders.

1.1 Design Principles

During the design procedure we kept in mind that our design had to be safe, economically and ecologically sustainable, economically feasible, and abide by Penn State's code of conduct and ethics. We also were required to communicate frequently with the team that was in charge of designing the device to launch the projectile, which caused us to shape and modify our design.

1.2 Gantt Chart



2.0 Project Background

Penn State College of Engineering students were asked to design and build a projectile and launcher that would be capable of safely delivering 100 milliliters of drink to fans at sporting events in the Bryce Jordan Center. Our team saw this as a great way to market drink companies' products. Penn State and our group recognized the opportunity to profit off of this marketing. All of this had to be done while keeping the prospective stakeholders in mind, which include Penn State, Pepsi, cheerleaders, basketball players, and individuals involved in them, just to name a few.

In order to determine possible designs for this project, our group researched various ways to slow down projectiles, equations involved in falling bodies, the nature and physics behind terminal velocity, aerodynamics, and various light and durable materials.

Much of the problem with this project lied in trying to determine how to create a design that was both aerodynamic and capable of slowing down to a safe speed, all while fitting in its launcher.

3.0 Project Objective

Based on the research we conducted and the information we gathered, we determined a basic set of Parameters. We found that our projectile design must be lightweight, inexpensive, durable, reusable, and must fit within the dimensions of its launcher. We took this basic information into account, and used it to generate specifications for our design. The specification then helped us determine our final design amongst all of our brainstormed ideas. The problem in our part of the project was determining how to slow our projectile down enough for it not to hurt any people or equipment.

3.1 Problem Statement

We want to assist beverage companies in advertising their drinks to fans at a sporting events, and we want to profit off of the design of a mechanism that allows the beverage to fall safely into the hands of the fans.

3.2 Specifications

<u>Stakeholder Needs</u>	<u>Specifications</u>
Pennsylvania State University and the project engineers would like the product to be cost efficient so both sides can profit off of the product.	The prototype must cost less than \$10 to build.
Penn State, beverage companies, and the designers would like the product to be reusable and durable to fit the characteristic of sustainable.	The product must be able to withstand a fall of 10 feet and be returned so it can be re-used.
Pennsylvania State University, owner of the Bryce Jordan Center, would like the product to be safe so the flying beverage doesn't harm fans.	Deliver drinks to fans under 2.5 m/s
The fans receiving the beverage would like the beverage to quench their thirst	The device must hold at least 100mL of fluid
Our counterpart launcher team would like our projectile to be able to fit inside of their launcher so the two items are compatible.	Must be less than 3 inches in diameter.

4.0 Conceptual Designs

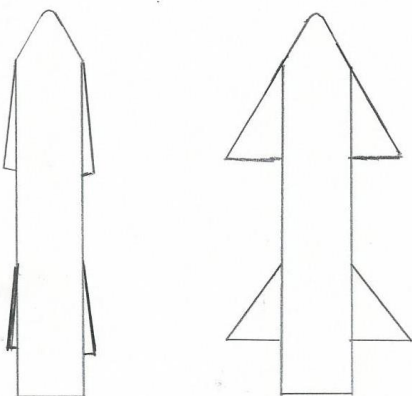
After defining the problem, determining customer needs, and interpreting those customer needs to specifications, we created five brainstorm ideas. The conceptual designs are shown in 4.1 through 4.5.

4.1 Idea 1



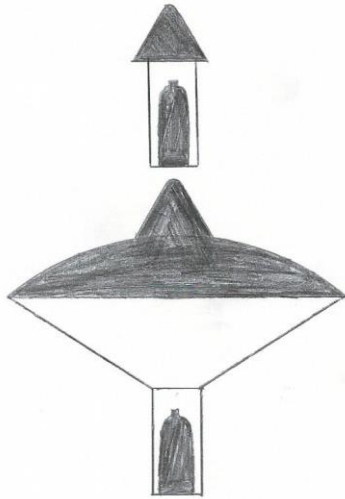
In this design, the system is shaped like a bottle on its ascent. At the peak of the flight, the umbrella style parachute would slide out of the top and deploy, slowing the system as it falls.

4.2 Idea 2



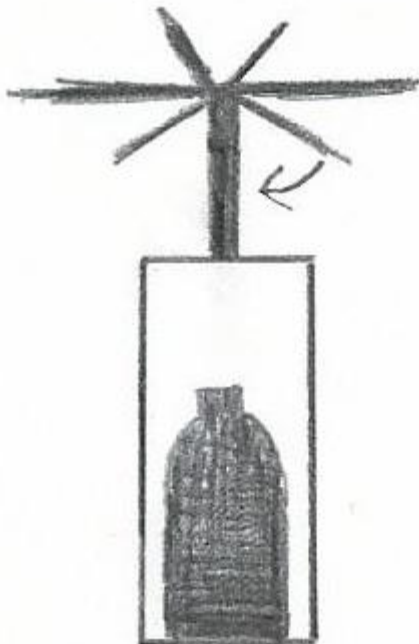
This brainstorm idea consisted of a rocket style system with flaps on either side of the fuselage. On ascent the rocket would be streamline through the air because the moving air around it would push the flaps flush against the fuselage. At the peak, moving air would cause the flaps to open, which would slow the rocket down on its descent.

4.3 Idea 3



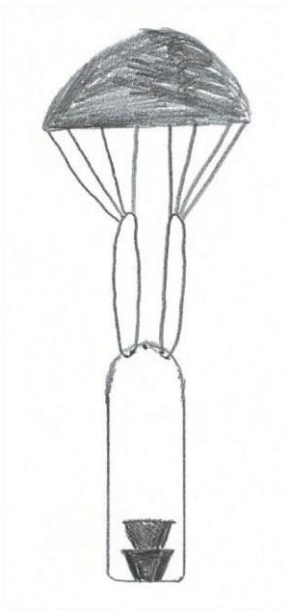
This design featured a rocket style fuselage with the beverage contained inside of it. At the peak of its flight, the nose cone could separate and air would rush into the parachute causing it to open out from underneath the nose cone. The parachute would glide the system safely into the crowd.

4.4 Idea 4



Idea 4 was designed after a maple tree seed. The idea behind is was that the blades would be angled in a way that caused them to spin and slow the system down. On the way up the blades would be flush against the rod holding them up, and on the way down the air would force the blades to open.

4.5 Idea 5



Brainstorm idea five was also a rocket style system. The beverage is contained within the fuselage and the parachute is attached to the top of the body. The parachute is designed more like a skydiver's parachute. It would deploy at the peak from the airflow getting into it. The parachute splits into two strings on either side, and then each of those two strings split again. This allows more stability when falling.

5.0 Concept Selection

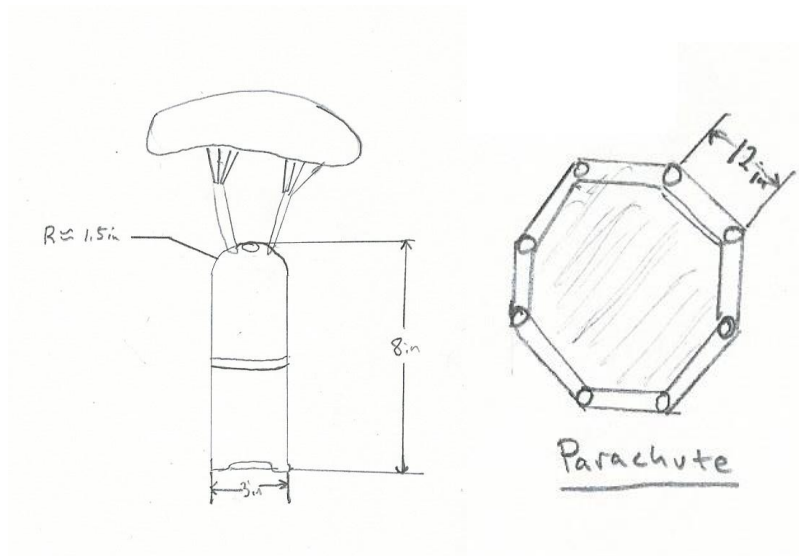
	Design 1	Design 2	Design 3	Design 4	Design 5
Ease of Launch	+	+	-	-	+
Safety	+	0	-	0	0
Strength	+	-	0	0	-
Ease of Build	-	+	-	0	0
portability	0	+	0	+	+
weight	0	+	0	-	+
cost	+	+	-	-	0
accuracy	0	0	0	0	-
plus	4	5	0	1	3
minus	1	1	4	3	2
net	3	4	-4	-2	1
rank	2	1	5	4	3
continue?	yes	yes	no	no	yes

Selection Criteria	Weight	Rating 1	Score 1	Rating 2	Score 2	Rating 5	Score 5
Ease of launch	20%	4	0.8	3	0.6	4	0.8
safety	20%	4	0.8	1	0.2	3	0.6
strength	10%	2	0.2	1	0.1	3	0.3
ease of build	10%	1	0.1	4	0.4	2	0.2
portability	5%	2	0.1	4	0.2	1	0.05
weight	15%	2	0.3	3	0.45	3	0.45
cost	15%	2	0.3	3	0.45	3	0.45
accuracy	5%	1	0.05	1	0.05	1	0.05
Total	100%	18	2.65	20	2.45	20	2.9
Develop?			no		no		yes

After reviewing our design matrices and rating each design, we chose to develop design 5.

6.0 Detailed Design

After we decided to use this design, we continued to further develop this design. First, we decided to use trash bags to make out parachute out of. We had to perform an experiment to determine the drag coefficient of the bag. Once we determined the drag coefficient, we were able to find the area of parachute needed to slow our projectile to 2.5 meters per second. Based on our calculations, we needed .45 square meters of material. We decided to make the diameter of our projectile 3 inches in order of it to fit tightly inside of the barrel. This whole design is durable and made entirely out of recyclable materials, so that at its end of life the projectile can still be used for something.



7.0 Conclusion

For our design we focused on the projectile part of the beverage launcher system. We finished with a rocket style design that contained the beverage within it and deployed a parachute at the peak of its flight in order to safely land in the crowd. The design has its limits because the flight was not very controllable. Our project was intended to advertise beverage companies and

quench the thirst of fans while making a profit. The design we have proposed will meet the need of the customer.

8.0 References

- terminal velocity (2013). (1st ed.) Oxford University Press
- PARACHUTES: REMARKABLE NEW DESIGN. (1928,). The Times of India (1861-Current