ME 1030-02

Final Research Paper - Trebuchet

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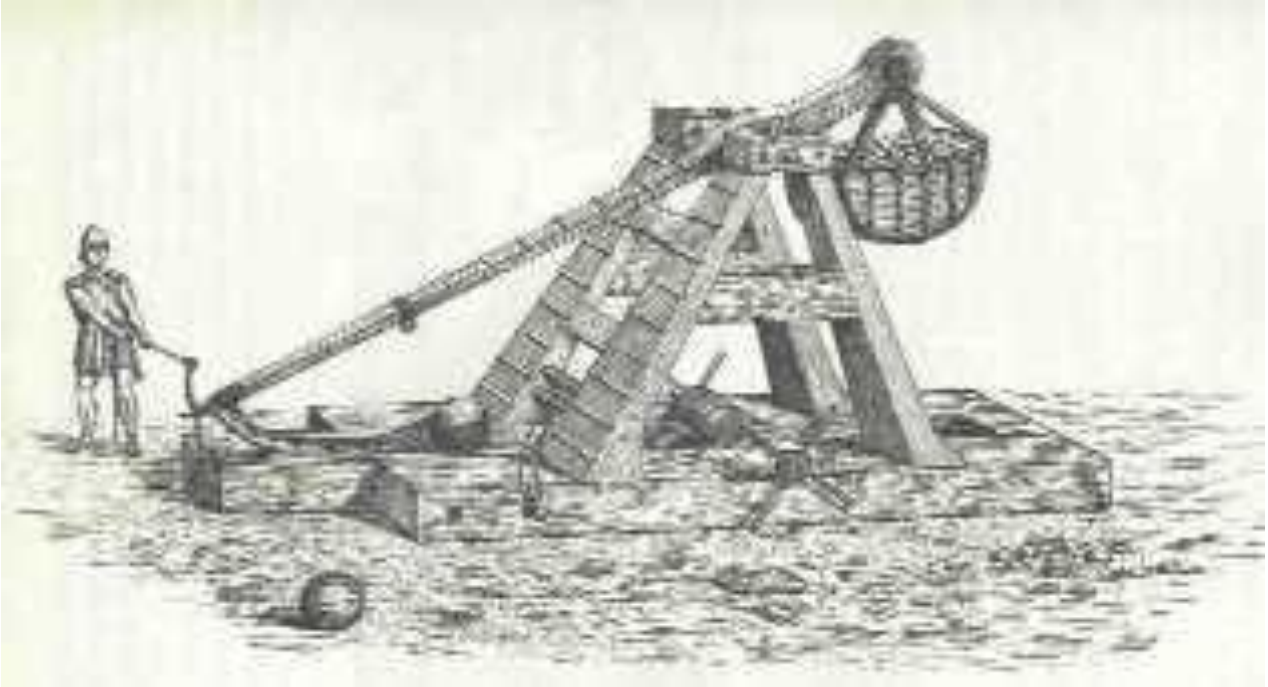
Abstract

Trebuchets are a mechanical device designed for attacking and defending castles and many other defensive buildings, it was best in use form 500 B.C.E. up until the canon was the new dominate force on the battlefield. This paper describes how to design a trebuchet and the background of the device, and why it was created. The use of modern day software/computers allows for the understanding of the physics of the trebuchet, it will also allow for a concept design in full scale before the real life product would be made. This paper will further the research and design of how to produce a trebuchet. In the findings of this project the trebuchet is a very complex device that a change of any one factor will result in a large change of distance and max highest the projectile flung by the trebuchet can reach.

Purpose

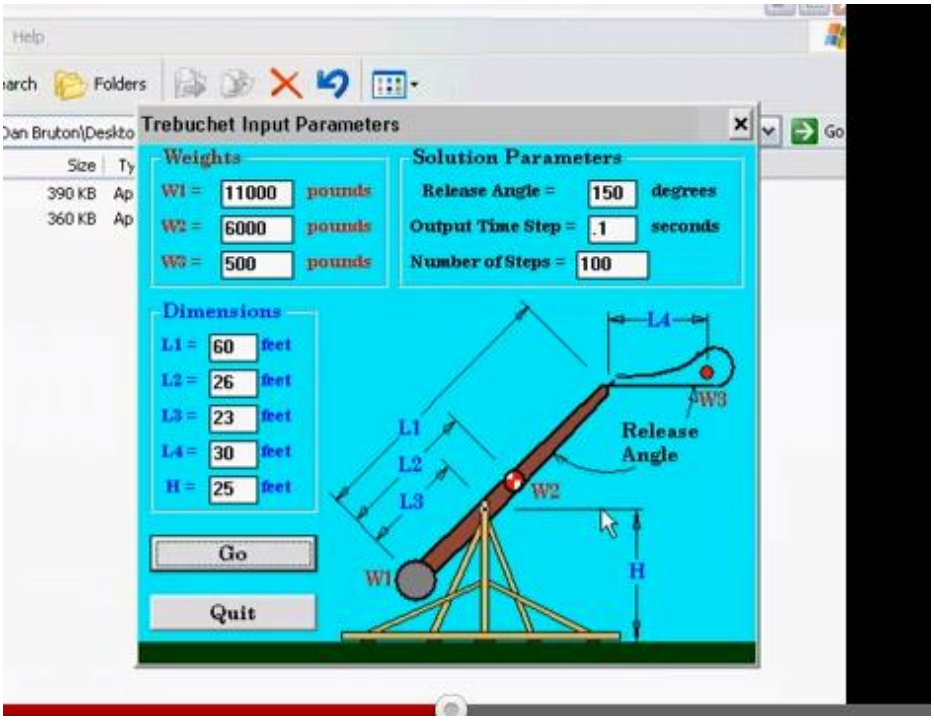
The purpose to writing this report is to develop material research and development of a product, along with the capability of the best or the only design produced. This is also to further the knowledge of the machine mechanics we made.



Research and literature review

The reason why this mechanical device, the trebuchet was developed was to fling objects further then what a human can. It was designed for war around by the Chinese between the fifth and third centuries B.C.E (Chevedden 1). This machine was used for both attack and defense of areas, able to inflict damage to walls at a distance of 160 meters with the missile weighing between 13 to 27 kilograms (Chevedden 1). Due to the popularity of this device many counties adopted the design of the trebuchet by around 1216 when France used it to attack a castle (History). Nowadays many of the trebuchets made are for fun or competitions flinging for the most part pumpkins. People try to develop a trebuchet under a set of rules and try to maximize the design to shoot either the furthest or the most accurate. In the past however the machine was used to throw almost anything that would be deadly (e.g. dead body/animal pledged, stone). The trebuchets

made today are mostly made of metal or strong particle wood or pressure treated, where back then they had logs cut right from a tree.

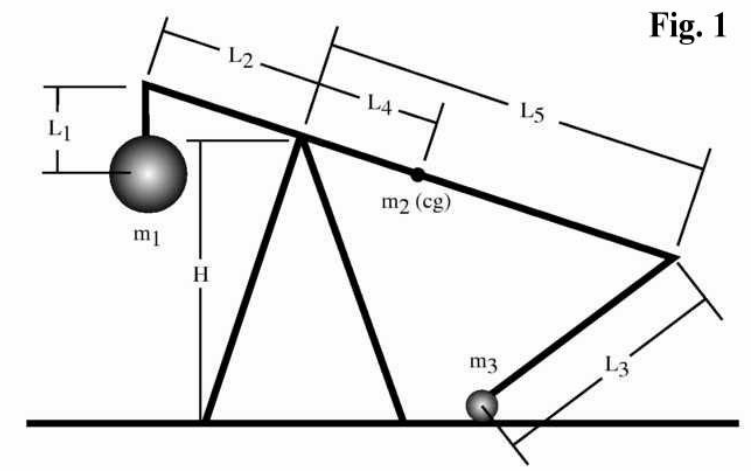


Research and development programs at Wright-Patt Air Force Base I would assume would love to have people working for them that put the time and effort into reports like this one. But for getting jobs only related to research production of trebuchets would have to be trebuchet organizations and historical evidence engineering analyst to recreate the a historical event and other information that would be useful for uncovering the past.

The Stephen F. Austin State University used produced a homework assignment with the use of the software WinTreb (see above) to further the understanding of excel, CAD, and Dynamic Modeling Software. This software is a very useful tool in designing a quick model of what could be produced in Solidworks other CAD software's and also a real life scale of the product.

Design

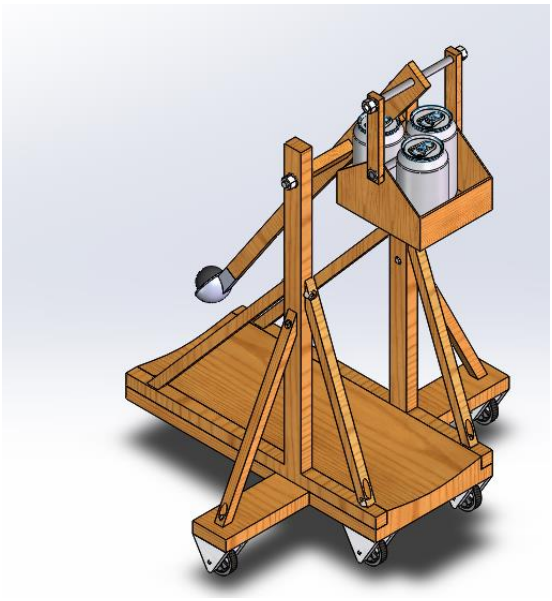
Sketches



I will be using particle wood for the main part of the frame to keep it from snapping due to the high forces produce while the arm whips around the axes. The base will have to be wood due to the restrictions set by the Wright State tournament regulations, keeping all metal away from the flesh bottom.

Using WinTreb the sizes I came up with to throw the squash ball 40-60 feet, keeping well above the minimum 25feet so it would not break the regulations. All of the specifications limits were taken from Wright States Website for the trebuchet competition for fall of 2012. M1 for the 3 average pop can is 1170 grams, I would use tango from the UK that is about 1260 grams (about 2.777lb.). M3 could be assumed to be .27 lb. M2 could be located half a foot away from the axis weighing about 1.5 lb = L4. L3 would be .8 feet long. The optimal release angle would be 45 degrees but do to the size of the weights it would be best to have something more close to 35 degrees. The height of the axis would be set to the max allowed since this would not affect any other dimensions

being .5 meters away from the ground. The max length and width of the top pivoting lever would also be set to the maximum allowed being .91 meters and ¼" thick respectively; also noting that the L3 length, the sling, is included in the maximum measurement of the total arm length. The length of the weight arm is just enough to clear the weight size from the pivoting motion that is produced by the trebuchet.



Using SolidWorks I produced a quick design of some of the requirements of the project. The mass includes the shape and size of the 3 soda cans that would be used in the real life product. The only thing that could not be produced was the sling that would be attached to the end of the swing arm to allow for the projectile to track its' course of motion.

I also made a basic bill of materials that would be used when gating a shopping list of what to build the trebuchet out of and the funds needed to purchase them. It also included basic specs that would define the object even more.

Bill-of-Materials

Material	#	Price	Specs
Soda Pop Cans - (Tango unopened)	3	$(75)x3	420 (1260)grams
Soft Squash Balls	3	$(2.99)x10	.27lb
Wood	2	$(10.47)x2	3/4" x 2' x 4'
Weight 2- lead	1	$ 8.99	Pack of ¾" 24 pack
Sling	1	$ 16.44	Black hardware net
Wood Screws	12	$ 7.98	
Bolts/washers	6	$ 1.00	
Lube	1	$ 7.97	Premium synthetic clear lubricant
Total		$ 42.38	

Source of some prices homedepot.com

The reason why wood was selected was it is cheap and easy to produce objects with; the alternative would be to use copper pipes or aluminum square tubes and weld or solder them together. This would allow for higher weight limits and axes tensions produced. However this is not needed due to the size of the trebuchet only using maximum of 3 pounds of weight, even cardboard would be effective enough to hold the trebuchet and project the projectile. But with cardboard it is fragile to compression so any accidental bumps could create structural problems. This is why the use of particle board was thought of.

Analysis

Due to the structural design of the trebuchet it can have many different maximum payloads due to the type of material it is made of and the counter weight sizes. While using WinTreb I had to experiment with many of these types of changes including release

angle, lengths of many arms and wood pieces. In changing the distance of the arm and the weights lengths away from the axes would change values by about 1 to 5 feet while the weights stay the same. When the weight values would change like for example Coca-Cola vs. 7up, the projectile would change by about 1 to 10 feet.

Conclusion

I have learned that this device was an engineering technological breakthrough that helped the way of thinking and production of products. This has taught me now to use programs designed for specific tasks, making me want to do this type of thing for other problems needed to be solved. I suggest when people do a research paper about trebuchets to build and test the design in SolidWorks or some other CAD program that has simulation. This will help predict quickly the real world optimal scenarios that would happen with the trebuchet.

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Used in **Research and literature review**

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