



Abstract

The purpose of team Farscape Engineering Co. is to design and assess the viability of burying fiber optic and power cable in the lunar regolith using a self-propelled battery powered machine. The importance of this challenge stems from the greater goal of a permanent human presence on the moon, which requires lunar habitats to have both power and the ability to communicate locally without being dependent on earth as a relay, thus it is imperative to develop a solution that would allow an operator to safely lay fiber optic and power lines in a convenient and reliable manner. To achieve the design goal the team is currently in the conceptual design phase, having determined reasonable constraints and using information from literature review to make appropriate assumptions about the lunar regolith. Currently the team plans to begin 3D modeling various components of the machine and plans on prototyping and testing digging implements in November.

Background – Underground Cable Laying Machine

Burying cable underground protects the cable from being damaged by environmental hazards. Using a machine to cut a trench, lay the cable and cover the trench makes the process of burying the cable quick and easy. In smaller scale work, closer to the focus of this project, the machines use a digging mechanism to pull dirt up and cut a trench into the soil. Cable will then be laid into the trench right behind the cutting mechanism or laid into the trench via a secondary machine. After the cable is laid the trench is covered and the soil is packed over to protect the cable.

Project Objectives

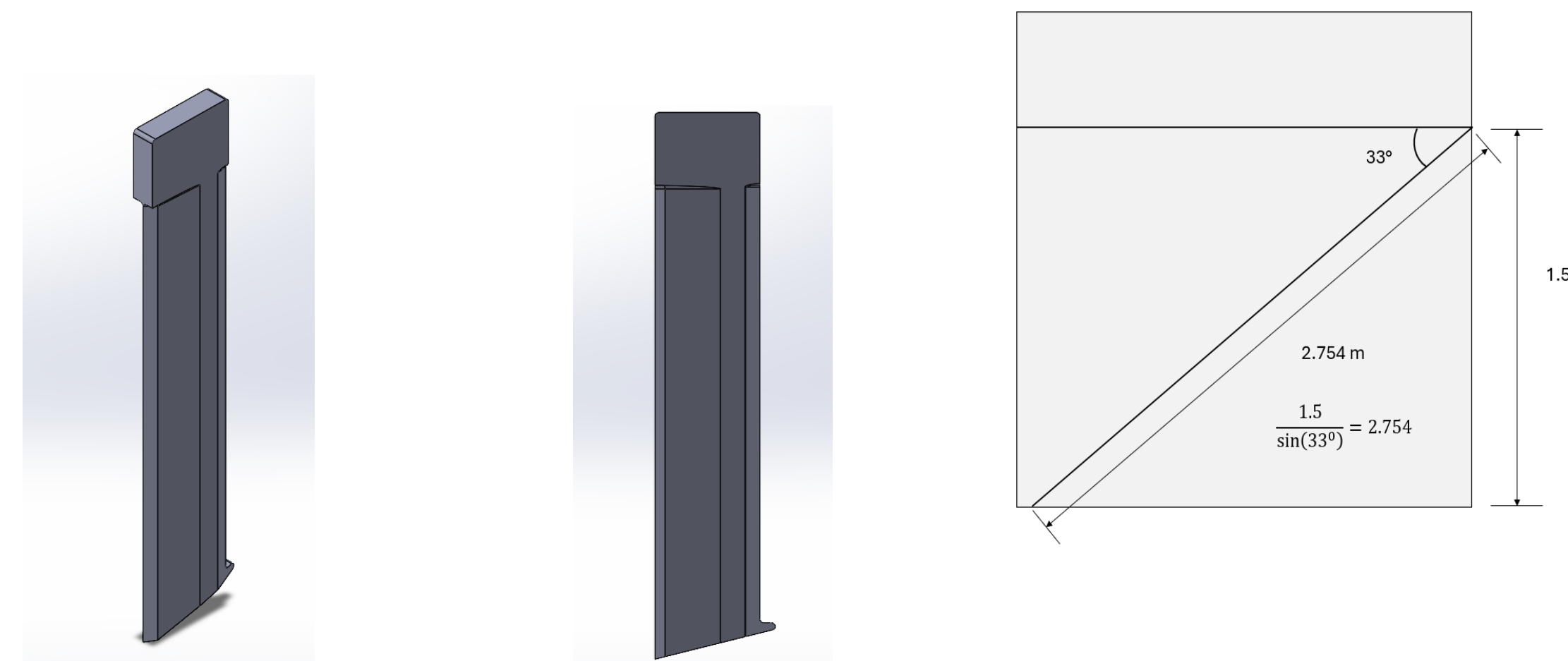
- Design and Test a machine that buries fiberoptic and power cable 1.5m into the lunar regolith.
- Manufacture a small-scale prototype.
- Test viability of design through simulation and lab tests using the prototype.

Expectations of Lunar Surface and Lunar Regolith

The properties of the lunar regolith differ greatly from that of the Earth. The lunar regolith is made up of fine dust and pieces of rock that can be described as a silt or fine sand. These particles are abrasive and also electrically charged from the Sun which can cause the regolith to stick to materials and equipment. Gravity is also an important factor to take into consideration as it is 1.62 m/s² compared to 9.81 m/s² on Earth. This needs to be noted to find a solution to ensure that the cable being laid down does not float out of the trench.

Current Progress

A generic plow blade has been designed based around the design of Ditch Witch vibratory plows used in sandy or silty soils. The design aspects based on these pre-existing plows include the cutting angle, blade thickness and width, cutting edge angle. The overall length of the blade was found using the depth/sin(cutting angle). This design is the current focus for the low number of moving parts to prevent wear from charged dust particles.



Assumptions

The 1.5-meter depth of the cable was assumed around the depth used on Earth for cables buried in loose soil and high traffic areas, because the regolith acts like sand. The size of the cable is assumed to be no larger than 2cm. NASA is planning on having nuclear generators available on the moon during the deployment of this machine that will be the primary power source.

Examples on Earth

The most common example of the underground cable laying machine for residential areas where the depth and size of cable like what will be used on the moon is the Ditch Witch. These machines are used by either companies or rented by individuals to lay cable in yards within a variety of soil types. The two most common types are the continuous bucket chain type and the vibratory plow. The chain type moves the greatest amount of dirt but requires a second run to cover and pack soil into the trench. While the plow type disturbs the least amount of soil, being considered "trenchless" requiring minimum work to cover the trench once it's been cut.



Testing

While the team has not yet reached the testing phase. The current plan for testing is to simulate lunar regolith using slightly moistened cement and a trough to test the effectiveness of the prototyped vibratory plow mounted on a working scale model of the machine. Later in the prototyping process the same setup will be used to test the cable feed and trench filling mechanisms.

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