

# Farscape Engineering Co.

Dept. of Mechanical & Industrial Engineering At TAMUK

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### 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. To keep the connection reliable and the wires safe, we estimate a depth of 1 meter is required. Having determined reasonable constraints and using information from literature review to make appropriate assumptions about the lunar regolith, the first design iteration of the machine using a vibratory plow is currently in progress.

### Background – Underground Cable Laying Machine

- Buried cable is protected from environmental hazards, human traffic, and animals.
- Using a machine to put the cable underground quickens the process and reduces the chance for error.

- Cutting mechanism cuts and pulls dirt up.
- Cable is laid into trench, via the cutting mechanism or a separate motor.
- The trench is then filled and packed over the cable to protect it.

### Project Objectives

- Design and Test a machine that buries fiber optic and power cable 1 meter into the lunar regolith.
- Manufacture a small-scale prototype.
- Test viability of design through simulation and lab tests using the prototype.

### Assumptions

- The cable depth is needed to be around 1 meter deep.
- Above the cable will have high traffic of people and vehicles.
- The size of the cable is assumed to be no larger than 2 centimeters.
- NASA is planning on having nuclear generators available on the moon during the deployment of this machine that will be the primary power source.

### Lunar Environment

#### Lunar Regolith

- Made up of fine dust and pieces of rock and can be described as a fine sand or silt.
- Abrasive and electrically charged particles which can cause them to stick to equipment.
- Density of 1.30 g/cm at the surface and increases with depth.

#### Gravity

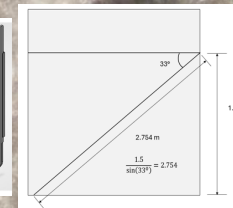
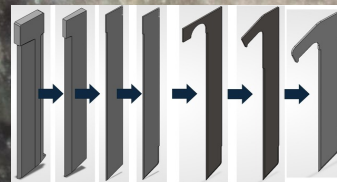
- The gravity on the moon is around  $1.62 \text{ m/s}^2$ .

### Current Progress

- Inspired by vibratory plows used in sandy/silty soils
- Size and shape based around these pre-existing designs
  - Thickness
  - Cutting angle
  - Width
- Blade length found using  $\text{depth}/\sin(\text{cutting angle})$
- Low number of moving parts
  - Reduced complexity
  - Fewer parts to fail due to wear from dust particles

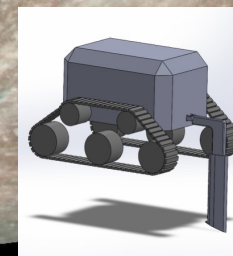
### Examples on Earth

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.



### Current Conceptual Design

- A very Geometric body.
- Angling plow arm
- Track design (Up for debate)



### Future Work

- Perform mathematical analysis to validate our design.
- Refine CAD model.
- Manufacture a prototype.
- Design a test using simulated lunar regolith to assess the viability of the design.

### Acknowledgements

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