

Abstract

Team Gamma Rays is tasked with the development of a design capable of scavenging and recycling previously discarded mission hardware. Additionally, the design must have conceptual tools, robotic attachments as well as be sustainable.

Project Background

- Resources from previous lunar missions have been left on the Moon. Mission hardware ranging from structural frames to electronics [1].
- NASA is investigating methods to recycle and reuse materials from previous or future lunar missions [2].
- Currently, there aren't any methods to recover, recycle, nor repurpose these components.



Figure 1. Apollo 17 Lunar Rover [3]

Objectives

- Project Objective:** Develop a lunar rover tow vehicle with the capability to collect payloads from the previous missions, specifically rovers
- Key Requirements:**
 - Energy Efficient
 - Semi-Autonomous
 - Payload Handling

Design & Analysis

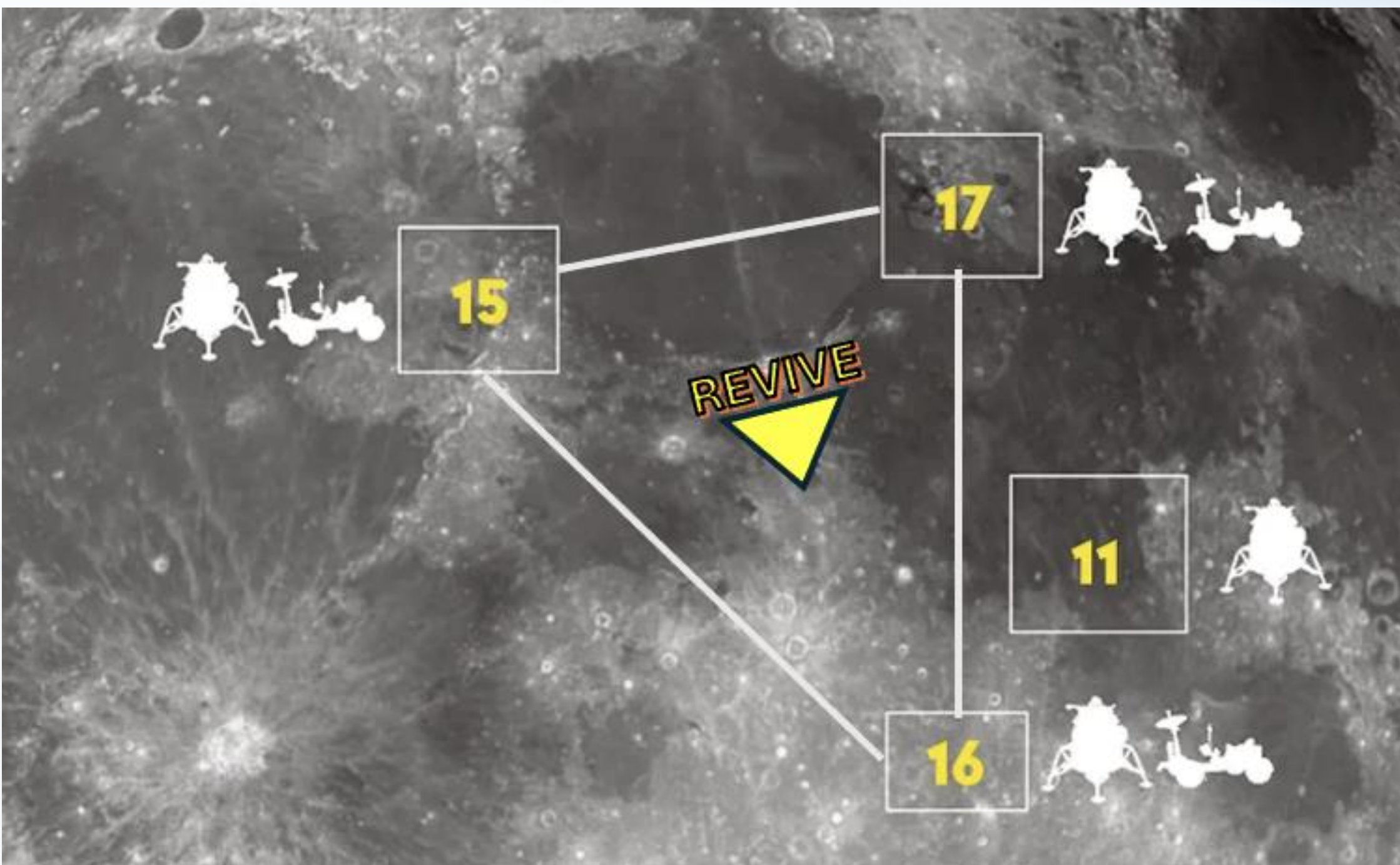


Figure 2. Triangle Distance

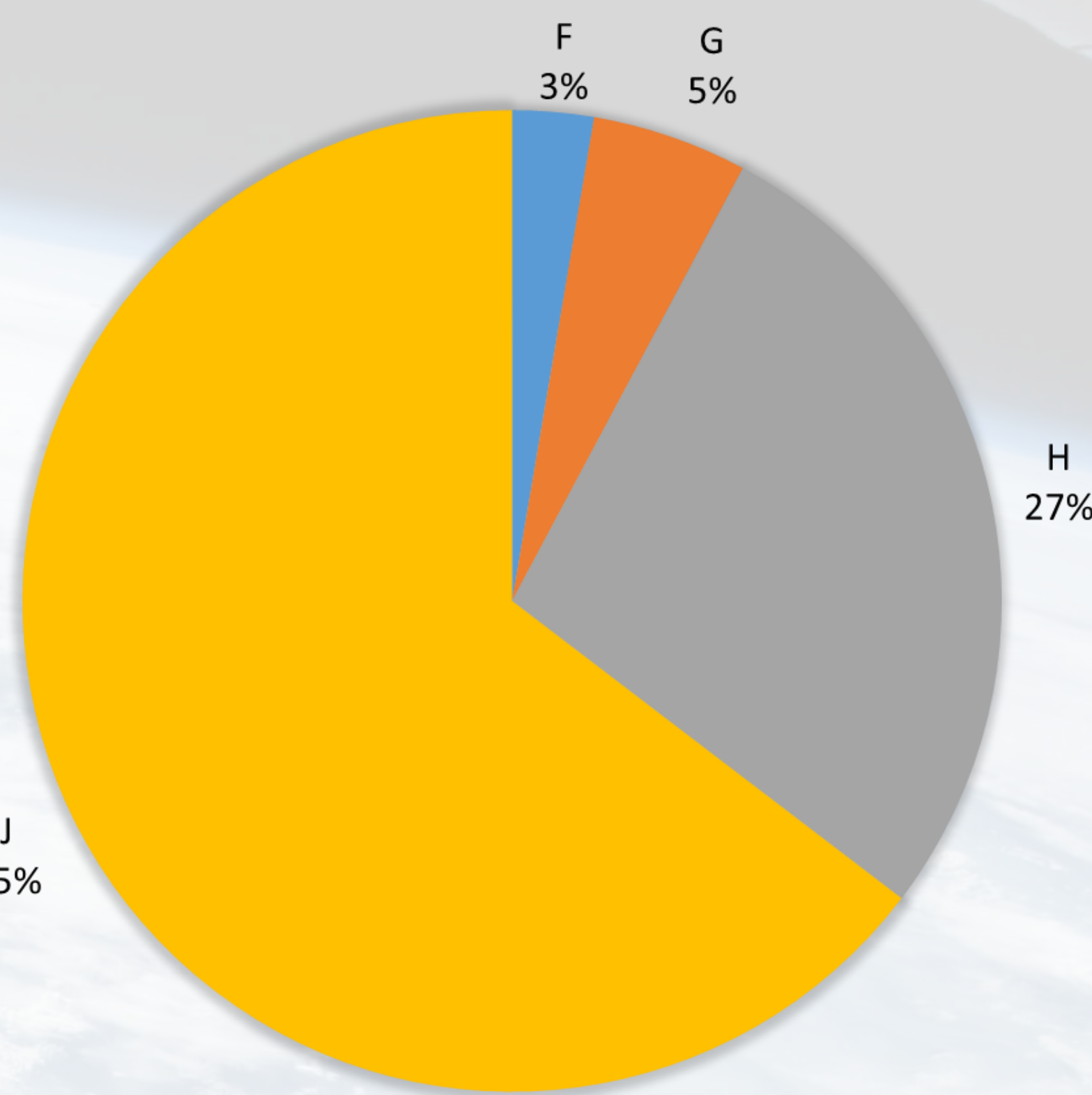


Figure 3. Breakdown of Apollo Missions Payload

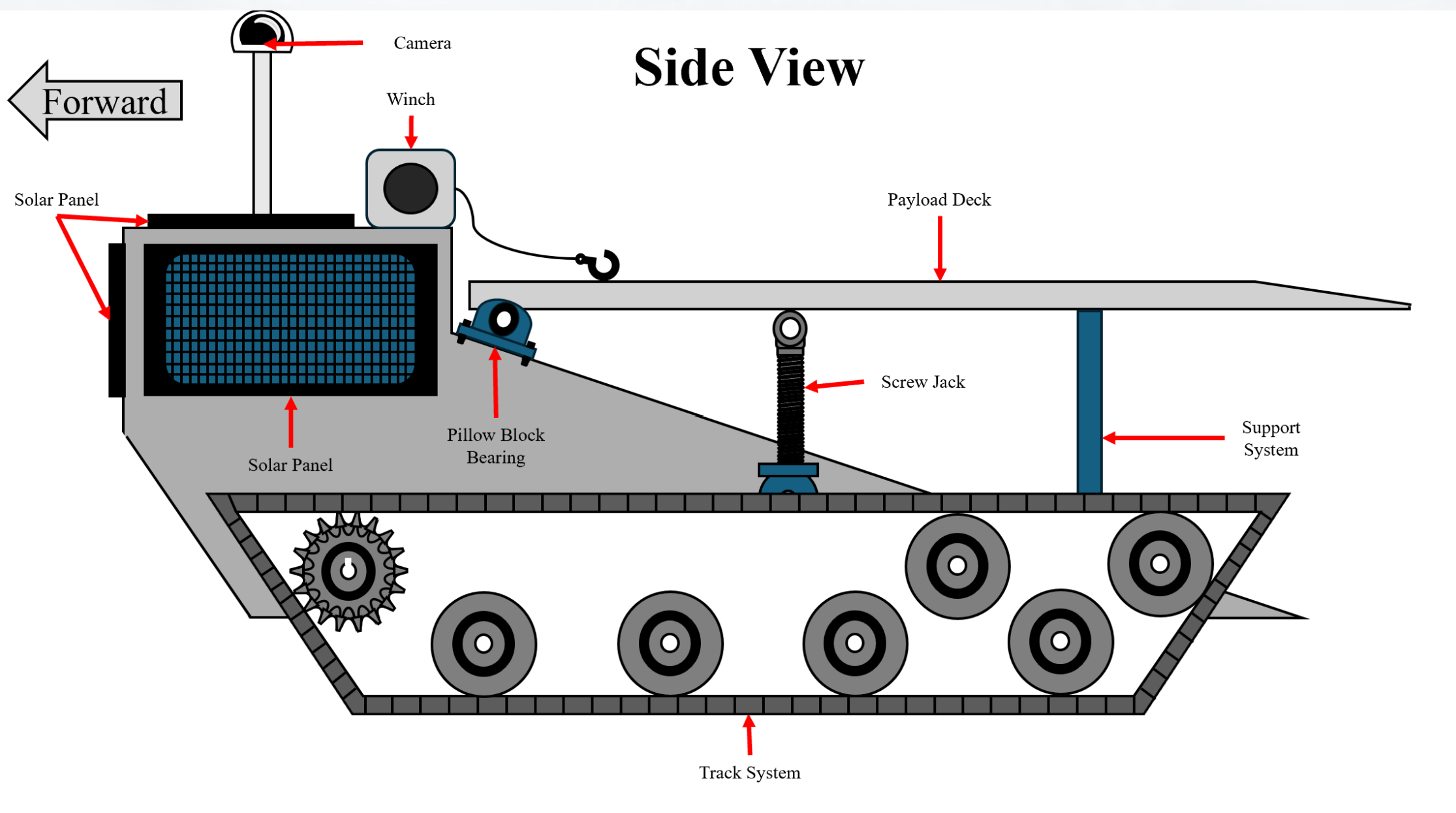


Figure 4. Concept Model Side View

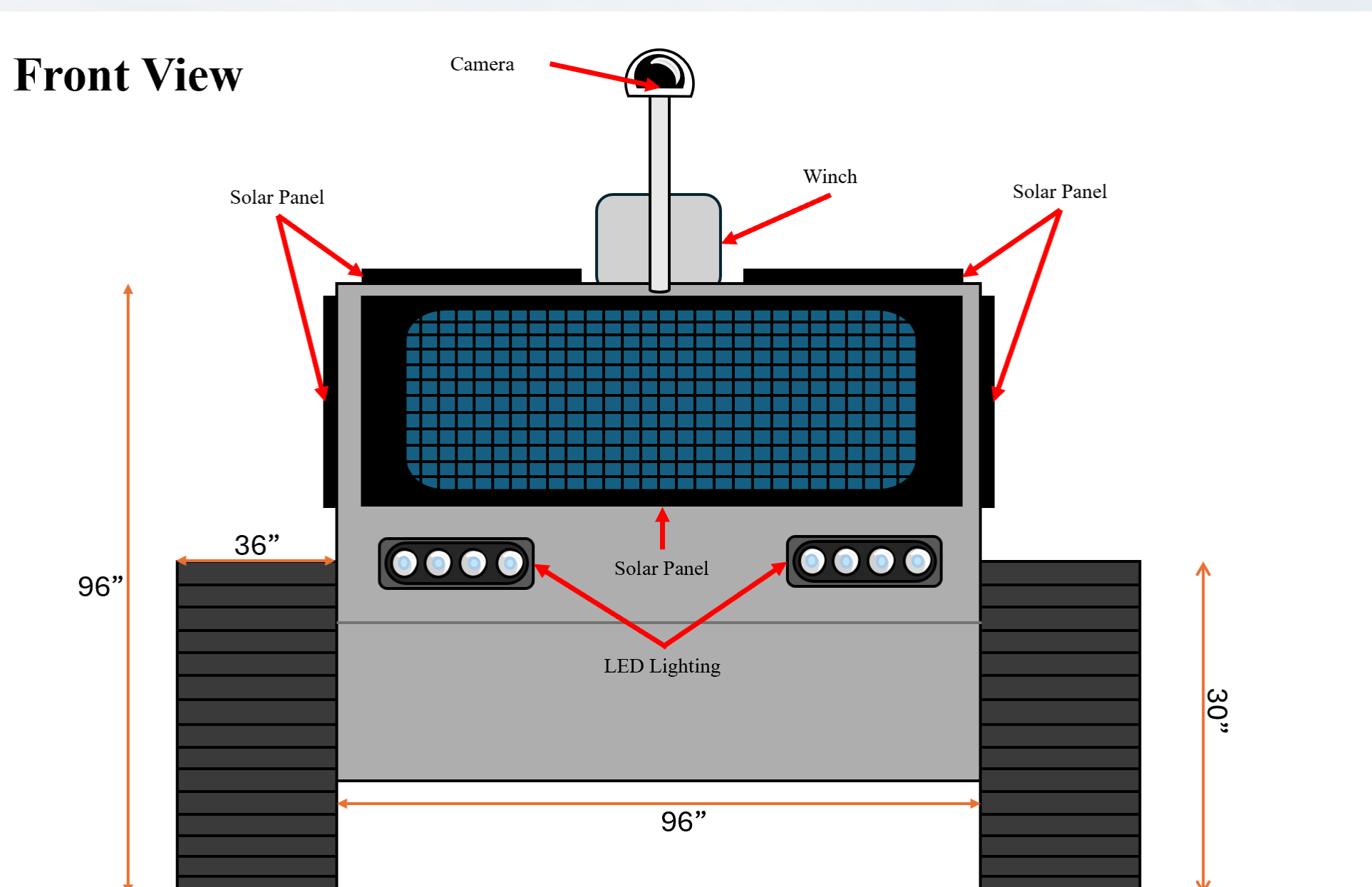


Figure 5. Concept Model Front View

Table 1. Pi Theorem

Pi Theorem	
π_1	$\frac{b}{L}$
π_2	$\frac{W}{\rho g L^3}$
π_3	$\frac{c}{\rho g L}$
π_4	$\frac{V}{\sqrt{gL}}$
π_5	$\frac{T}{W}$
π_6	$\tan\phi$

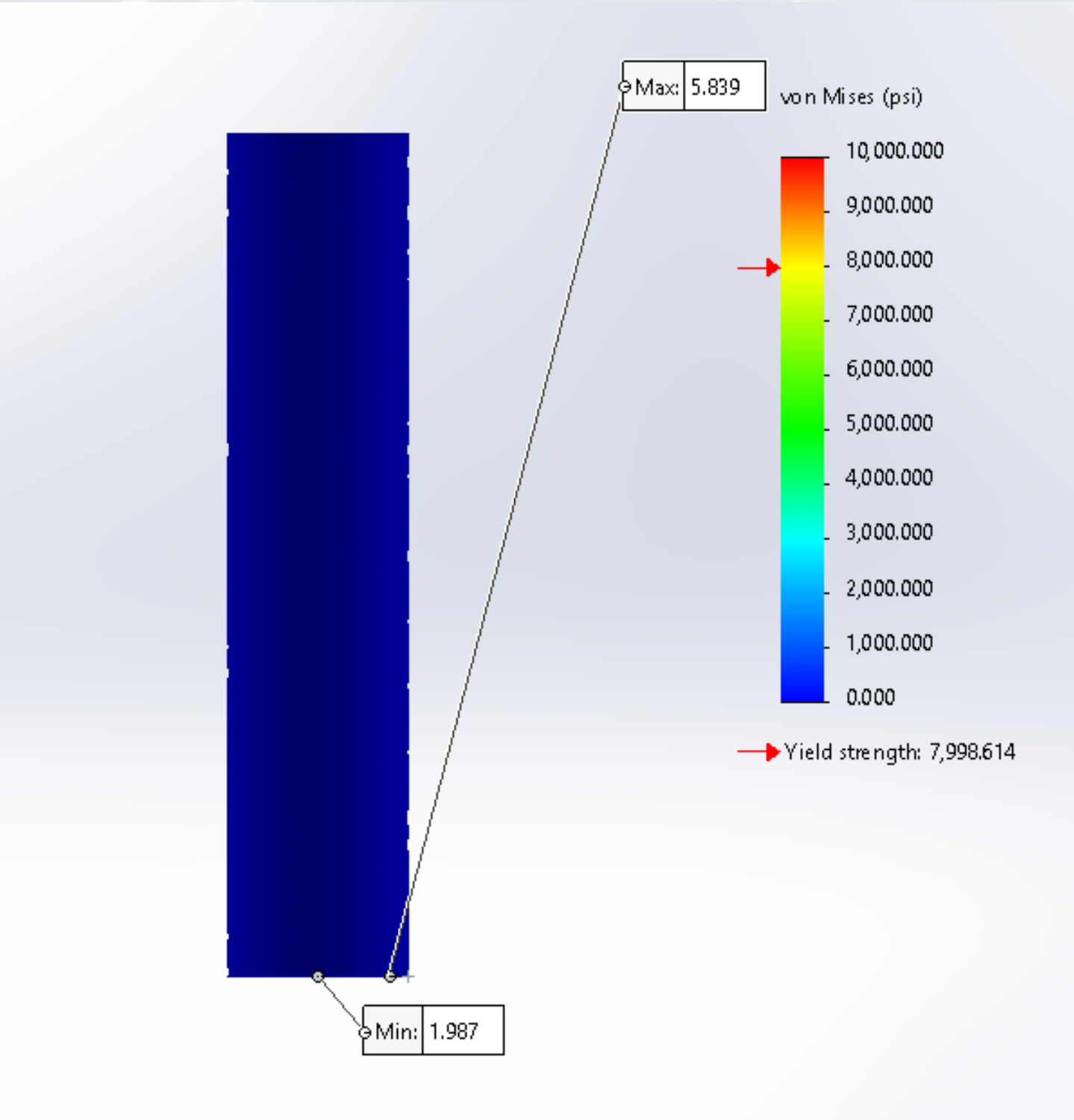


Figure 6. von Mises analysis

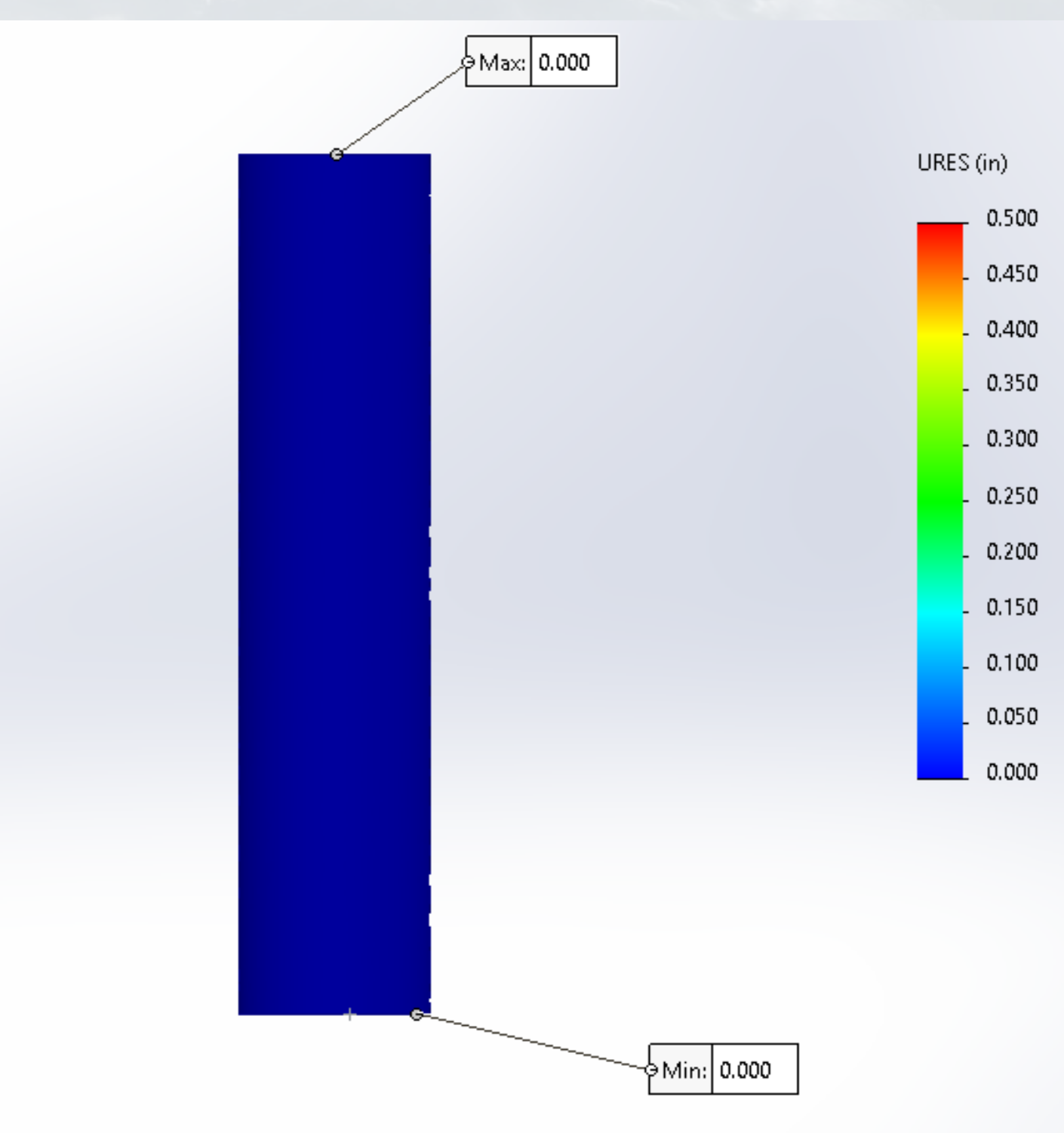


Figure 7. Displacement analysis

Future Work

- Create a scaled down prototype
- Test prototype under fabricated lunar environment
- Continue research and development of semi-autonomy
- Adopt autonomy of "go-home" function
- Present findings

CONCLUSIONS

The Gamma Rays have created a hypothetical 1:1 lunar rover which would be able to haul the Apollo Rovers to repurpose their materials. To determine the most optimal path and approach, triangulation was used to gain insights into the distance needed to travel—as well as a center point between the three rovers. To ensure accuracy, a scaled down prototype will be created by leveraging the Pi Theorem. Additionally, FEA was performed to validate the design and material selection.

References

[1] Thomas A. Sullivan .” Catalog of Apollo Experiment Operations.”<https://www.nasa.gov/wp-content/uploads/static/history/alsj/RP-1994-1317.pdf?>

[2] Bullard, Savannah. “NASA Seeks Innovators for Lunar Waste Competition.” <https://www.nasa.gov/news-release/nasa-seeks-innovators-for-lunar-waste-competition/>

[3] Photo by NASA on Unsplash

[4] How to See the Apollo Landing Sites. BBC Sky at Night Magazine. <https://www.skyatnightmagazine.com/advice/skills/see-apollo-landing-sites-moon>

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