

Cosmic Commanders

Lunar Activities Base (L.A.B.)

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ABSTRACT

- This project aims to develop a lunar habitat that will serve as a home base for astronauts.
- The key challenge with the habitat design is needing to withstand the harsh environment of the Moon, where extreme temperature fluctuations, lunar regolith abrasion, and constant bombardment from solar radiation are the norm.
- The habitat is designed to withstand not only these conditions, but the extreme forces experienced during ascent.

PROJECT BACKGROUND

- Establishing a long-term human presence on the Moon.
- Creating a habitat that will house astronauts for durations on the scale of years is essential to this focus.
- Designing a habitat that is manufacturable on Earth and ready for use on the moon.

OBJECTIVES

- Create a sustainable lunar habitat to advance and support NASA lunar exploration.

The habitat must meet or exceed:

- Mass is compatible with chosen vehicle
- Usable surface area of ~50-80 m²
- Thermal range -130 to +120 °C
- Radiation protection of $10 \frac{g}{cm^2}$
- Assembly time of < 30 days

Final Design

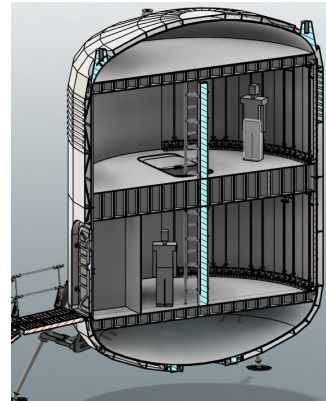
- The hull and structural components are made of Constellium Airware® 2195-T84 high strength aluminum alloy that is CNC machined and friction stir welded together. The overall dimensions of the habitat come to 6.5 m dia. x 8.6 m in height. The L.A.B. consists of 2 floors, each having a height of 2.5 meters, and a diameter of 6.12 meters.

Whipple Shield Components: Kevlar & Aluminum

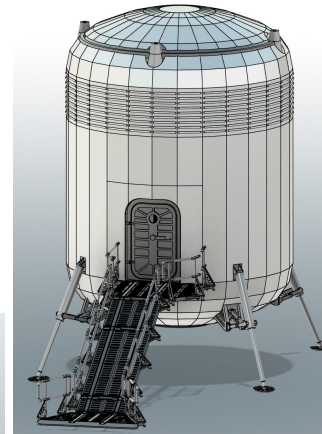
Thermal Protection: Multi-Layer Insulation (MLI)



Hull Design



Cutaway View



Final Design of L.A.B.



Legs Added to Prototype

1:15 Prototype Manufacturing

- Re-purposed and re-sized air compressor tank to build main hull
- Legs made from sheet metal & metal tubing; spring loaded
- Isogrid made from expanded sheet metal and 9-gauge wire
- 3D printed PLA for interior and cosmetic parts



Welding Floors



Interior Flooring Added to Prototype

FUTURE WORK

- Further studies into potential weight reduction
- Integrating berthing ports to connect multiple habitats together
- Improvement on double airlock concept to eliminate regolith contamination within the habitat.

CONCLUSION

- The Lunar Activities Base provides a safe module for astronauts to live on the moon for extended amounts of time.
- The L.A.B. can take the rigors of ascent and the surface of the moon through its robust, yet minimalist design for a lightweight and durable construction.
- Although possible improvements could be made regarding size and material optimization, the L.A.B. is a feasible step forward for non-earth habitation.

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REFERENCES

