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Space Architecture: Habitats, Habitability, and Bases (1)

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NEW DESIGN APPROACH FOR LUNAR HABITATION IN LAVA TUBES - LUNAE ABYSSI
PROJECT DESCRIPTION AND DETAILS

Abstract

The paper outlines the design process of an awarded project: a lunar station situated within a lava tube, developed for the Moon Station Competition organized by YAC - Young Architects Competitions and the ESA Topical Teams on Planetary Caves of the European Space Agency. The design, crafted by a team of Polish space architects from Space is More and recognized concept artists.

The competition tasked participants with proposing a concept for the first moon research base located in Lacus Mortis, an area providing access to a lava tube. This unique setting prompted an exploration of novel approaches driven by the distinctive conditions of the lava tube and the mission's objective of early colonization. Consequently, the result was an original modular structural concept with distributed functionality.

The settlement comprises four aluminium modules, each featuring a dual-layer inflatable shell prefabricated on Earth and transported to the lunar base. While each unit operates independently, they collectively contribute to the sustainability and functionality of the lunar settlement. The surrounding infrastructure encompasses 3D-printed landing pads equipped with storage and fuel depots, along with an intricate road network connecting to ISRU processing refineries and Small Modular Fission Power Plants. The proposed building technologies combine safer solutions for transporting modular and prefabricated components from Earth with in-situ technologies yet to be explored.

Crafting the ideal station for Moon colonization demands striking the perfect balance between functionality and comfort, integrating engineering design with consideration for the full spectrum of human needs. The mission's scope necessitated catering to a research crew, maintenance team, and tourists sent to the Moon. The four units serve distinct functions: an observatory, mission control center, recreation module, and research center module. While optimizing the functionality of each module was paramount, numerous design decisions were made to enhance the mental health and psychological well-being of the crew. Furthermore, the design team drew from their experience operating the LunAres Research Station, an analog space mission simulation facility located in the city of Pila, Poland.

The paper presents a forward-looking vision for lunar colonization, combining innovative architecture with a keen focus on the holistic needs of future lunar inhabitants. The scope of the presentation includes the design and decision-making process, drawings and visualisations and final analysis and conclusions.