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ADDITIVE MANUFACTURING FOR LUNAR HABITATS: A SUSTAINABLE APPROACH TO MOON BASE CONSTRUCTION

Abstract

The Moon is regarded as a strategic stepping stone for humanity's permanent presence in space. With its potential to serve as a logistical hub for scientific research, deep space exploration, and future Mars missions, the Moon also stands out as a unique focal point for the space industry due to its rich natural resources and low gravity. A permanent lunar base would enable in-situ resource utilization (ISRU) for fuel and construction material production while also providing an ideal location for radio astronomy and geological studies, accelerating scientific discoveries. Therefore, establishing a sustainable base on the Moon is a crucial step in advancing technology and shaping humanity's future in space. For a future lunar base that we plan to establish and expand sustainably over time, the most cost-effective method for producing construction materials is additive manufacturing (3D printing). Structures created with additive manufacturing are both cost-efficient compared to alternative production methods and, due to the nature of the technique, can incorporate complex geometries. This study will conduct a technical analysis of the potential use of lunar-derived materials as feedstock for additive manufacturing, their suitability for constructing habitable structures, the additive manufacturing methods applicable to lunar conditions, and the technical and financial feasibility of an additive manufacturing system required for a medium-scale human habitat. Additionally, an evaluation will be made on the geometric configurations that could be used for various potential construction materials, including those sourced from the Moon.