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PRELIMINARY STUDIES ON THE USE OF REFLECTED SUNLIGHT AS EFFICIENT SYSTEM FOR CREW COMFORT AT A LUNAR OUTPOST

Abstract

Building infrastructures on the Moon that will support temporary and long-term crew faces multiple challenges, including extreme temperatures (fluctuations), harmful radiations, the cycles of 14 days daylight-14 days night, and the transportation challenge. The preliminary study on the use of reflected sunlight, as a solution for illumination and human comfort at a lunar outpost, that directly addresses the three first challenges has shown that use of reflective mirrors has great potential for the design of a more sustainable and more liveable base.

The illuminated areas can be used for passive energy systems and an enhanced indoor comfort for the crew. The reflected sunlight enables localised radiant heating which increases thermal comfort while reducing the need for extremely insulated outer walls. Using different geometries and materials for the mirrors contributes to visual comfort by blocking out harmful radiations while still providing light of different shades and intensities. This paper is a qualitative and quantitative follow-up study on the preliminary research. It presents more in-depth research on the use of reflective mirrors for Permanently Shadowed Regions (PSR's) on the lunar poles; specific location, shape, size, angle and material of the mirrors. Results include the analysis of how the reflection can be directed in specific areas of the crater and how different levels of light diffusion can be achieved. In order to understand diffusion of the sunlight and therefore the heating of the surface of the crater (which enables radiant heating and the loss of frozen water from the surface), matters of scales were addressed in the simulation which enables more in depth calculations and light simulations.

The other, further investigated aspect was the contribution of the mirrors in terms of indoor comfort. The study presents the use of secondary mirrors together with a rotating system, which enable "daylight" rhythms at the outpost. These rhythms will govern the circadian rhythm of the crew, increasing their comfort and wellbeing. The paper also speculates on the additional potential use of the rotating mirrors system such as: solar energy production, water extraction, which could be the deciding factor into exploring the use of reflective mirrors for a lunar outpost.