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A TECHNICAL SOLUTION FOR WINDOWS IN MASS-SCREENED LUNAR HABITATS

Abstract

In recent years, a renewed interest in Lunar exploration has arisen once again. A review of experiences on prior missions on the Moon shows that there are significant challenges related to establishing a base for humans in the harsh Lunar environment. If the Earth's surface is protected by its magnetosphere and its atmosphere against cosmic radiation, solar flares, and micro-meteoritic debris, the Lunar surface, instead, has no overall magnetic field that deflects charged particles and no radiation-absorbing and debris-consuming atmosphere at all. The possibility of protecting human beings from radiation and debris by exploiting passive screening techniques, using the locally available regolith to build a thick massive envelope, is effective, but it has an intrinsic drawback: the buildings must have small windows, or even no windows at all. As was proven by many studies carried out since the 1950s in Terrestrial harsh environments such as deserts, undersea, and the Antarctic, in Isolated and Confined Environments (ICEs), as Lunar habitats are, Habitability and Human Factors (HHF) are critical issues that can dramatically affect crewmembers' wellness. Among them is the possibility of an external view. Thus, the provision of windows in Lunar habitats that exploit massive or high-density passive radiation screening is likely to enhance the crew's psychological wellness, mitigate stressors that can deteriorate performance in accomplishing mission tasks, strengthen spatial awareness, allow external activities monitoring, and use of natural lighting, reducing energy consumption, as well. Generally, the technical solutions conceived so far to provide habitats with windows or alternative devices consisted of small observation posts equipped with shutters that protect from both radiation and debris, as that one installed in the International Space Station (ISS) or virtual screens which, although they can be effective, do not allow a direct view of the external environment and the exploitation of natural lighting. The paper takes up and develops studies conducted over time on the technical feasibility of windows in Lunar habitats, proposing an alternative system based on image reflection which is compatible with a massive envelope and can both allow direct observation and protect against radiation exposure and the impact of micrometeorites. The technological system proposed allows to provide habitats with windows suitable for the direct view of the external environment, mitigates psychological effects derived from long stays in ICEs, enhances operational task control, to contribute to crew's safety, foreseeing further application.