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HYBRID HABITAT FOR MARS: CREATING COMFORT WITH LIGHT.

Abstract

In terms of space architecture, the biggest technological challenges towards manned missions on Mars, are radiation protection as well as the use of ISRU. The design for a space habitat therefore calls for a technology driven design, often using material sciences as starting point. However, the use of this methodology can overlook architectural aspects that are important for the well-being of the crew, which is, in turn, critical for the completion of the mission.

This project focuses on the beneficial aspect of introducing daylight in a working/living environment. Therefore, a preliminary research tested the translucency of different materials in extreme cold [-70 C] to simulate the Martian environment. The use of two distinct materials were found to comply well to all the qualitative as well as the quantitative requirements. These two materials form the structural element for the hybrid habitat as well as form a radiation protection for the crew. The first material is found abundantly on Mars and is the main structural element: ice. As first barrier with the Martian environment, the translucent material will let daylight in the habitat, meaning that day and night changes can be felt by the crew which will reduce their overall anxiety and homesickness. Ice also has peculiar properties that can reinforce the structural elements of the habitat depending on the outdoor climate. It also has repairing properties that no other material possess which is critical for a redundant design. The second material will ensure most of the thermal insulation as well as the secondary structure of the habitat. This material is not found on Mars but can be sourced from the atmosphere using ISRU: polycarbonate (PC). This secondary structure consist of the finished interior walls and windows, as PC resists well under low temperatures and is relatively easy to make as no high pressure is required. Both the ice and PC are excellent against radiation, especially PC which traps secondary radiation. As the indoor partition walls are made from PC, this will increase the radiation protection within the core of the habitat. By cleverly designing the functions and layout, less material is needed to build this hybrid habitat. Most importantly, as these PC walls are also translucent, shadows will be seen from one room to another. This will improve the overall comfort of the crew as they interact both with themselves and with the outdoor environment via the radiation shielding windows.