

30th IAA SYMPOSIUM ON SPACE AND SOCIETY (E5)
Space Architecture: Habitats, Habitability, and Bases (1B)

Author: Ms. Mahsa Moghimi Esfandabadi
University of Houston, United States, mesfand@uh.edu

Prof. Olga Bannova
University of Houston, United States, obannova@central.uh.edu

MARTIAN GREENHOUSE ARCHITECTURE: ENABLING HABITABILITY, SAFETY AND
AESTHETICS**Abstract**

A Greenhouse system in the partial gravity of Mars requires integration of subsystems for air and water circulation and distribution, lighting, cultivation, and monitoring. According to NASA's Big Idea Challenge competition, Mars Ice Home should provide power, air, and water supply through an interface to an adjacent but separate greenhouse module. At large, the module will require Mars Ice House resources for building its structure and functionality. Although having a separate greenhouse structure may be the most efficient use of space, it will restrict the crew from regular interactions with nature especially in a long-stay (conjunction class) mission to Mars and cause psychological deconditioning. This paper presents a Martian greenhouse design based on the human factors and aesthetics integration in the overall greenhouse architecture. Regarding the concept of operation, the greenhouse does not operate independently and has no independent closed loop system. Therefore, adding water consumption for sanitary, laundry, and kitchen functions would not affect the overall amount of water storage. In addition, relocating a gym from the habitat to the greenhouse is beneficial for the air quality of the habitat and excessive production of carbon dioxide is beneficial for plants growth. An indoor garden with public space for social interactions and personal space for private time would support crew morale and improve their quality of life. In a summary, this paper presents the criteria for trade studies concerning the maximum cultivation area of a greenhouse with more human-centered spaces. Interior design examples are compared and qualitatively evaluated based on their effectiveness from the viewpoint of volume and area utilization, systems requirements, human activities and psychological support and aesthetics.