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Space Architecture: Habitats, Habitability, and Bases (1A)

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DEFINING BEST DESIGN PRACTICES FOR SAFETY AND COMFORT IN MOON AND MARS HABITATS

Abstract

Safety requirements are critical in designing habitats for extreme environments on Earth and in Space. However, satisfying only safety requirements will not guarantee mission success. Crew performance can be improved by means of comfort and functional design considerations that accommodate their physical and psychological needs. Currently, common habitat design approach is based on linear processes satisfying technical requirements of the mission and providing necessary life support for the crew. Nevertheless, to ensure their well-being and productivity, aesthetics and ergonomics aspects have to be given equal attention throughout the whole design process. Safety and comfort factors are to be considered while meeting requirements of hardware structural and technical constraints. Habitat occupancy duration is also a major factor in determining the minimum required comfort level.

Such habitats need to satisfy exceptional requirements for construction, environmental protection, food production, living conditions and maintenance; they have to ensure safety and emergency response protocols, support crew's physical health, morale, and productivity. Such strategies fundamentally changes the approach to designing habitats and equipment.

This paper presents results of the technical research to define the best design practices and recommendations derived from experiences on the medium-duration orbiting facilities and extreme environment missions on Earth. The investigated case studies include Skylab, Spacelab, Salyut 7, Mir, and the International Space Station; orbital spacecraft system Shuttle; polar research stations in the Antarctica and Arctic; as well as Earth-based human space mission simulators (ex.Mars Desert Research Station (MDSR), Mars-500/Sirius-19, Aquarius and NASA Extreme Environment Mission Operations (NEEMO) . The research aims to dene the optimal balance between the necessary levels of comfort and safety for the crew and associated implications to the spacecraft or habitat design. In addition, key results from international studies on innovative technologies and structures for habitats, radiation protection, and regenerative life support systems are analyzed and summarized. The paper summarizes current major problems in the habitat design and discusses a new architectural strategy to creating innovative and eective habitation systems for space.