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EXPANDABLE AND ADAPTIVE MODULAR DESIGN HABITATS USING IN-SITU LUNAR
RESOURCES FOR FUTURE MOON SURFACE MISSIONS WITHIN THE FRAMEWORK OF THE
DEEP SPACE GATEWAY

Abstract

In order to have Lunar surface activities with crewed missions, there is certainly the need of outposts that would be able to support life and provide protection in the extreme environment of outer space. For this purpose, several concepts for permanent lunar bases have been proposed. Among these designs, some of them highlight expandability and others concepts have the advantage of being structurally sound however, they do not consider aspects such as the availability of lunar construction materials, modular design, mobility and expandability all at the same time.

In this paper we present a modular architecture for a sustainable lunar habitat taking into account the properties of isokinetic structures and the possibility of in-situ resources utilization. The overall concept would allow a mission crew of four to live and work on the Moon's surface, in a mission design where the Deep Space Gateway plays a major role. The proposed solution presents the idea of an isokinetic expandable geodesic dome as the main and internal structure. This structure is completed by a particular layer design, made from a pattern of empty triangular-based pyramids to be filled by regolith and/or lunarcrete enabling at the same time a future growth of the habitat as well as provide a protection shield against outer environment. The enclosed habitat will be placed into the interested spot by means of teleoperated rovers, within current mission architecture designs enabling an international collaboration for having the Moon as a stepping stone toward other celestial bodies. For this design we have taken into consideration the lunar environment, construction methods and materials, structural systems and design loads among other parameters. We also understand the role of human and robots, their performances and their interactions during the development and completion of the mission. Other aspects such as life-support systems, interior design and regolith processing will be studied within the next steps of the work.

This habitat requires achieved and available technology and fits perfectly within the current mission architecture designs proposed by space agencies in the Global Exploration Roadmap. Therefore, having a permanent lunar base as a research station on Moon's surface may become a reality within the next decades, expanding our frontiers and open new opportunities for research.

Keywords: Habitat, Crewed Mission, Global Exploration Roadmap, Deep Space Gateway