

21st IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)  
Human Exploration of the Moon and Cislunar Space (1)

Author: Prof. Bernard Foing  
ESA/ESTEC, ILEWG & VU Amsterdam, The Netherlands, Bernard.Foing@esa.int

MOONVILLAGE CONCEPTS & DESIGNS TOWARDS A SUSTAINABLE AND PERMANENT  
HUMAN LUNAR BASE

**Abstract**

Moon Village Workshops at ESTEC and with community in 2015-2018 gathered a multi-disciplinary group of professionals from all around the world to discuss their ideas about the concept of a Moon Village, the vision of a permanent and sustainable lunar base within the next decades [1].

The Moon Habitat Design group identified that the lunar base design is strongly driven by the lunar environment, characterized by high radiation, meteoroids, abrasive dust particles, low gravity and vacuum. The base location is recommended to be near the poles to provide optimized illumination conditions for power generation, permanent communication to Earth, moderate temperature gradients at the surface and interesting subjects to scientific investigations. The abundance of nearby available resources, especially ice at the dark bottoms of craters, can be exploited in terms of In-Situ Resources Utilization (ISRU). The identified infrastructural requirements include a navigation, data- commlink network, storage facilities and sustainable use of resources. This involves a high degree of recycling, closed-loop life support and use of 3D-printing technology, which are all technologies with great potential for terrestrial spin-off applications. For the site planning of the Moon Village, proven ideas from urban planning on Earth should be taken into account. A couple of principles, which could improve the quality of a long-term living milieu on the Moon, are creating spacious environments, visibility between interior and exterior spaces, areas with flora, such as gardens and greenhouses, establishing a sustainable community and creating social places for astronauts to interact and relax.

The proposed establishment of the lunar base can be divided into 4 steps. First the primary base infrastructure is laid out through robotic missions, assisted by human tele-operations from Earth, from the lunar orbit, or via a human-tended orbital gateway station in Halo orbit. During the second phase, the first manned habitation surface module will be deployed. This module contains a bare minimum of functionality to support a small crew for a couple of months. During the third phase, additional modules with more dedicated functions will be sent to the Moon, in order to enhance functionality and to provide astronauts with more space and comfort for long-term missions. In the final phase of the lunar village, a new set of modules will be sent to the base in order to accommodate new arriving crew members, and evolution.

We thank participants to MoonVillage Design Community Workshops 2015-2018. References: [1] <http://sci.esa.int/ilewg/>