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

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CONCEPT OF SPACE SYSTEM ARCHITECTURE WITH HABITABLE BASE UTILIZATION FOR  
COMPLEX EXPLORATION OF THE MOON

**Abstract**

This article presents a concept of a Space System architecture for a comprehensive exploration of the Moon using a habitable lunar base. The goal of this Space System is to enable complex exploration and future developments on the surface of the moon with utilization of a broad range of diverse robotic systems. Construction and use of a habitable lunar base aims not to complicate but simplify the processes of control, maintenance and repair of robotic systems. Such a habitable base can also be used for other purposes, for example, for medical research, space tourism, etc. The architecture outlines a lunar base design, proposes a universal modular transportation system for carrying cosmonauts/astronauts and cargo, provides means for surface mobility for equipment and lander(s), and proposes a special system of artificial moon satellites to provide communication and navigation. Presented interdisciplinary collective scientific and technical project was developed within the framework of the International Youth Research School "Space Development: Theory and Practice - 2020" by an international team of more than 100 participants representing 14 countries. The summer school has been held annually for many years by Bauman Moscow State Technical University, and each year participants develop a new project on space issues. The choice of the theme of the project in 2020 was defined by the fact that the leading space countries have returned to the idea of mastering the Moon, seeing it as an integral part of the future space infrastructure in the Solar System.

The main objectives of the project were identified as:

- create reusable vehicles to provide regular passenger and cargo transportation between the Earth and Moon orbits with their design optimized by cost and safety;
- develop architecture of a long-term habitable lunar base to support crewed lunar missions;
- maximize use of robotics for major work on the surface;
- allow adjustments for modernization of the Space System for future In-Situ Resource Utilization.

The paper presents an analysis of technical feasibility of proposed solutions, a general design of the modular architecture of a habitable lunar base, and a robotic transportation platform.

The proposed concept of the Space System architecture offers potential for establishing a habitable base on the Moon, and its elements can be utilized for infrastructure development on other bodies in the Solar System. Work on the project demonstrated the importance of collaboration of space architects and engineers in overcoming difficulties of designing reliable systems for space habitats.