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MODULAR LUNAR VILLAGE CONCEPT DESIGN FOR LONG-TERM HABITATION LOCATED IN
LAVA TUBE**Abstract**

"Space Architecture Workshop, Moon Village Edition" was held at the Department of Architecture at Xi'an Jiaotong-Liverpool University in December 2023. This paper presents the work of a group of four students from the five-day workshop. The proposal is for a sustainable and expandable design for a moon village that can accommodate long-term human stays. The village will be located in the permanent day zone of the Shackleton Crater (south pole of the moon) and partially built in a lava tube. This project includes a lunar surface greenhouse, an underground residential area, public spaces, and research laboratories. Large parts of the building are located in the lava tube, where water ice resources probably exist, and cosmic radiation and other hazards on the lunar surface can be blocked. The construction concept of the project is based on prefabricated modular building units, which the SLS Launch system can transport in batches. At the beginning of the construction process, the launch vehicle will automatically transfer the prefabricated units to the Lunar Surface Robotic Factory, where they will be robotically processed and assembled. Then, the robots will transfer the core barrels and the platforms for the housing units into the lava tubes for the following assembly. Finally, prefabricated units will be installed on-site to create an enclosed environment suitable for human habitation. During the development process, the settlement evolves gradually downward. The number of platforms on the connection core increases to form a fully functional subsurface building since the capacity increases from 8 to nearly 30 crews. It is expected that six rockets will be needed to transfer modules for the construction of an underground tower. After a single underground tower reaches its maximum capacity, more towers will be built along the lava tubes. When the number of complexes reaches a certain level, a fully functioning lunar underground city will eventually be formed. The ecosystem in the plant greenhouse is a four-biotic chain-loop bioregenerative life support system consisting of humans, plants, animals, and microorganisms, ensuring the crew members' nutrient intake and creating a self-sufficient closed system. The surface greenhouse will also reduce psychological stress by simulating Earth's environment. Consequently, the present settlement can be destined for investigating terrestrial organisms' adaptability on the lunar surface, cultivating species that can improve the lunar environment, and preparing for the transformation of the moon into a habitable environment as an important milestone of the lunar settlement.