# Space Architecture technology for settlement and exploration on other planetary bodies – In-Situ Resource Utilisation (ISRU) based structures on the Moon

Conference or Workshop Item

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Space Architecture is the theory and practice of designing and building an extraterrestrial environment for human habitation. It combines engineering and aesthetics, requiring knowledge of space environments, space systems engineering, and the psychology of isolated and confined environments. Building a human habitat in hostile environments on other planets requires locally sourced and manufactured construction materials, known as *In-Situ* Resource Utilisation (ISRU), and a fully automated construction assembly. Because ISRU is one of the most important concepts in the potential realisation of a deep-space exploration and space architecture, a significant amount of ISRU-related research has been carried out over the past 4 decades. Over the last decade, Space Architecture has become an emerging issue for future space exploration, and is increasingly seen as a fundamental requirement for supporting long-term space exploration and settlement on other planetary bodies.

NASA has classified three types of extraterrestrial habitations as (i) Class I: pre-integrated hard-shell modules, e.g. the International Space Station; (ii) Class II: prefabricated and surface assembled modules, e.g. inflatable structures; and (iii) Class III: ISRU derived structures integrated with the Class I and II modules. As more and more complex lunar missions are planned by various space agencies, the topic of ISRU will gain prominence, and be of fundamental importance for the viability of such ambitious undertakings. Thus, those involved in the Space Architecture field believe ISRU is particularly important for deep-space exploration; for example, ISRU on the Moon would produce propellant, shielding materials, water and oxygen which can reduce the amount of mass launched from the Earth to other planets such as Mars, thereby saving billions of dollars of the space budget. They thus contemplate robotised Additive Manufacturing (AM) technologies as key technologies in the construction of Class III human habitations and infrastructure, including radiation shields, surface paving, bridges, dust-shield walls and spacecraft landing fields, etc.

In this presentation, a large-scale AM process focuses on the Built Environment – 3D Concrete Printing (3DCP), which can be considered as one of the potential technologies for Space Architecture, will be demonstrated followed by the challenges on construction activities on the Moon, potential local resources and an example of ISRU-based lunar outpost designs. The presentation will conclude with the recent effort on Space Architecture technology from European Space Agency (ESA).

***Keywords****: Extraterrestrial Architecture, Space Habitation, ISRU, Space Exploration*