26th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Human Exploration of Mars (2)

Author: Prof. Giancarlo Genta
Politecnico di Torino, Italy

Dr. Marco Peroni
Italy
Dr. Giacomo Ravaglia
Italy

# AN OUTPOST FOR THE FIRST HUMAN MARS MISSIONS

**Abstract**

The time for the first human mission to Mars is closing. If a split mission is designed, the habitat can be sent together with all the other material in a cargo mission, arriving on Mars about two years before the astronauts. There is plenty of time to build the outpost on site using robotic 3D-printing machines. The outpost must offer protection against radiation: while the ideal solution is active radiation protection, the relevant technology is still to be developed. The aim of this paper is to propose the design of a Martian outpost based on additive manufacturing and passive radiation protection for the first human missions to Mars. Similar habitats can be used also for a lunar base. Using Martian material makes it possible to build large buildings, the only limitation to the size of the habitat being the time the 3D-printing machine has for the construction work. For radiation protection, the structure should not have discontinuities, which excludes the possibility of having true windows. Virtual windows, (a thin-film screens, connected with a TV camera on the outside of the wall), provide a good illusion of true windows. The possibility of having large size rooms mitigates their drawbacks.

The outpost needs a radiation shelter, allowing the crew to survive even large solar particle events. If the sleeping rooms are located in the underground shelter, the colonists will spend about one third of their time in a completely radiation-free environment, reducing by one third the radiation dose absorbed. The building must contain 3 separate, air-tight, locations:

- Permanently pressurized parts (living quarters, lab, recreational area, shelter and sick bay), which must be always maintained at a pressure of about 1 bar or slightly less.
- A non-permanently pressurized part (garage for the rover(s) and workshop)
- The greenhouse, which can be kept at a pressure lower than 1 bar.

The airlock basic parts (the air tight doors, the pumps and all control devices) must be manufactured on Earth and carried to Mars, so they must be as light as possible. The structure is loaded by self-weight and pressure differential. Self-weight produces compressive loads, while pressure differential produces tensional loads. It is necessary to study the ability of the material obtained from regolith of withstanding tensile loads. To allow the construction by 3D printing, no flat slab can be used for roofs. Domes or barrel vaults must be used everywhere.