Paper ID: 32634
interactive

27th IAA SYMPOSIUM ON SPACE AND SOCIETY (E5)
Architecture for humans in space: design, engineering, concepts and mission planning (1)

Author: Ms. Christina Ciardullo
Carnegie Mellon University, United States

MARS ICE HOUSE: USING THE PHYSICS OF PHASE CHANGE IN 3D PRINTING A HABITAT WITH H20

Abstract

Mars Ice House was the first place winner of NASA's 2015 Centennial Challenge to 3D print a habitat for Mars using indigenous resources. Unlike most traditional design concepts making use of Martian regolith, Mars Ice House makes use of subsurface ice in the construction of a full 3D printed habitat made out of solid H2O. Citing new evidence of the potential hazards of perchlorates in the Martian soil, working within NASA's "follow the water" approach to exploration, and stemming from a human centered design approach wanting to connect largely interior habitats to the light and vistas of the surrounding landscape for human psychological wellbeing, H20 serves as a radiation barrier, absorbing shorter wavelength radiation, while allowing light through in the visible spectrum. The resultant is a 1000ft2 (9.2 m2) translucent vertical habitat with a maximum of surface visibility allowing visible light into the interior of the habitat. The design covers all potential aspects of construction from water collection approaches, concept of operations, and semi-autonomous robotic 3D printing approaches, all which exploit the manipulation of pressure and temperature to build with phase change as opposed to more laborious building techniques. Investigating several potential methods, Mars Ice House was able to demonstrate scaled 3D printing of ice as well as use small scale robotic technologies capable of building large scale structures. Furthermore the design of Mars Ice House proposes spatial and scalable approaches to building with solid H2O as a primary building material which support human health and wellbeing.