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HEXHAB 3D CONSTRUCTION-PRINTED PLANETARY HABITAT FOR EXTREME ENVIRONMENTS

Abstract

HexHab is a 3D constructed printed shelter designed for long-term occupancy in extreme, inhospitable planetary environments such as Mars or the Moon. Additive construction technology is used to autonomously construct a core shell structure which can then accommodate a variety of outfitting needs depending on mission goals and location. Described is an autonomous robotic excavation and construction sequence, coupled with construction printing technology using insitu materials, with "crewmember-in-the-loop" outfitting processes for a 3D printed habitat in a Mars environment.

The hexagon is a common and prevalent geometry of nature. Our HexHab design takes its cue from nature and relies on the simplicity and versatility of this geometric shape to provide a hexagonal form factor as a core shell to accommodate a variety of mission objectives for interior outfitting. The design is grounded in functionality and safety with a robust shell thickness for a radiation protective shelter for human habitation on distant worlds. To maximize internal volume, HexHab begins with a hexagonal footprint intersected with a dome to provide three levels of habitable volume and floor area. It is designed and outfitted for a crew of four to live and work comfortably for up to one year before crew replacement or rotation of consumables. Multiple ingress/egress access points and connection locations for rovers or addition of other modules are provided. The core shell is autonomously constructed prior to crew arrival, while the outfitting phase of inserting secondary structures involves a human and robotic partnership for completion of the habitat. Transport of large bulk outfitting items is robotic and crew assisted upon arrival of a construction outfitting crew. Our build process is graphically laid out around the site plan. Depicted are regolith, atmosphere and water processing to create our regolith and polyethylene feedstock. Feedstock mixing, piping to the printer, and HexHab site excavation, printing and outfitting are described.

Interior views of the three deck levels fully outfitted with mechanical services are presented.