ADDITIVE CONSTRUCTION TECHNOLOGY FOR LUNAR INFRASTRUCTURE.

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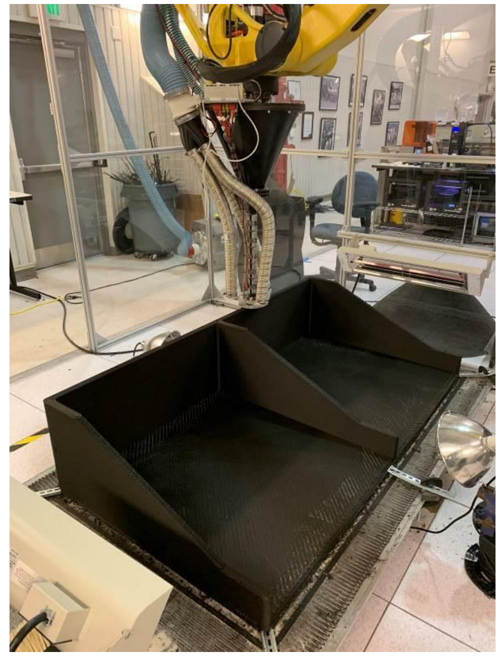
Introduction: Developing a lunar economy will require a significant amount of infrastructure on the Lunar surface. Humans will need to rely heavily on ISRU technologies to develop this infrastructure. One of the ISRU system's primary requirements will be to provide construction materials to build habitats, storage bins, landing pads, roads and other infrastructure.

One method of utilizing these ISRU derived construction materials is through Additive Construction, a method to "3D print buildings". The Granular Mechanics and Regolith Operations (GMRO) laboratory at the NASA Kennedy Space Center has developed and tested an extrusion based process for additive construction.

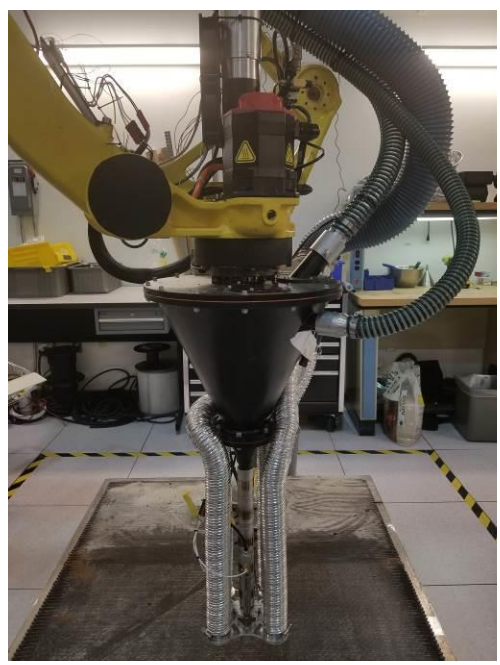
Materials: Several materials have been tested for this process, including mixture of granular lunar regolith simulant (BP1) and various polymers. However, it was found that material strengths can be drastically improved by using glass fiber. The material compound currently being used is a 70% basalt glass fiber and 30% PETG mixture. Basalt glass fiber can be created on the moon by melting and drawing the lunar regolith into fiber. This could be an incredibly valuable material for construction and manufacturing on the moon. Polymer binders would be made available in the form of astronaut trash, or bioplastics created from crops and algae that will be necessary for a human presence on the moon.

It is also possible to eliminate the polymer binders from the additive construction process completely. By directly sintering granular material or drawn glass fiber, structures can be created in situ without the need for polymers. The GMRO lab has investigated this and is continuing to research this option.

Emplacement: The emplacement mechanism used for additive construction testing in the GMRO lab is a large industrial robot arm with a custom designed extruder and feed system mounted to the end effector. For use on the lunar surface, many different emplacement mechanisms can be evaluated. Some options include, gantry machines, mobile robotic platforms, boom arms, cable driven machines, and more. Many of these strategies have different advantages. For example mobile robotic platforms can allow for faster construction with multiple robots that work together and reach into more extreme terrain.



Printed Infrastructure with Basalt Glass Fiber



Extrusion Based Print Head