



Space Technology

Game Changing Development

Additive Construction with Mobile Emplacement (ACME)

Overview and Purpose

The Additive Construction with Mobile Emplacement (ACME) project is developing technology to build structures on planetary surfaces using in-situ resources. The project focuses on the construction of both 2D (landing pads, roads, and structure foundations) and 3D (habitats, garages, radiation shelters, and other structures) infrastructure needs for planetary surface missions. The ACME project seeks to raise the Technology Readiness Level (TRL) of two components needed for planetary surface habitation and exploration: 3D additive construction (e.g., contour crafting), and excavation and handling technologies (to effectively and continuously produce in-situ feedstock). Additionally, the ACME project supports the research and development of new materials for planetary surface construction, with the goal of reducing the amount of material to be launched from Earth.

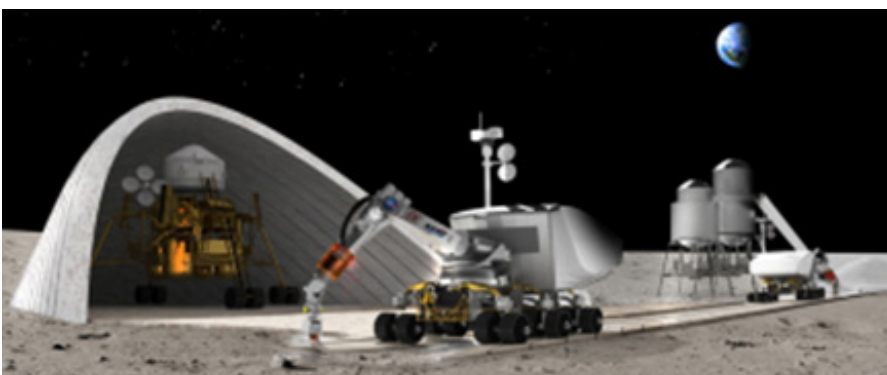
ACME is a joint venture between NASA's Space Technology Mission Directorate Game Changing Development Program and the United States Army Corps of Engineers (USACE). The USACE is interested in the additive construction technology as a means to build Army structures to enable field operations. The ACME project will help USACE minimize the number of people it takes to build

a structure, minimize the amount of time it takes to build a structure, allow digital design and 3D printing of structures to resemble local buildings, and reduce the amount of material brought into the field and waste produced by the construction process. These goals are similar to those of NASA in the establishment of planetary surface mission infrastructure.

The ACME Team

ACME combines the expertise, technologies, and goals of NASA's Marshall Space Flight Center (MSFC), NASA's Kennedy Space Center (KSC), the USACE, Contour Crafting Corporation (CCC), and the Pacific International Space Center for Exploration Systems. The project plans to 1) be the first demonstration of additive construction using planetary analog materials, 2) investigate binder and regolith mixtures, as well as construction materials made from regolith, to identify optimal planetary construction materials, 3) provide a detailed analysis of materials for additive construction on different planets, including radiation shielding potential, 4) advance the TRL of additive construction hardware and processes to provide risk reduction and capabilities to future missions, 5) provide the gateway to fabricating structures on demand in space with in-situ resources, reducing the need for sizeable structure up-mass, 6) provide

NASAfacts



Artist rendering of potential emplacement devices and garages/roads to be fabricated with an ACME device.

a significant return on investment by enabling future NASA missions not feasible without the capability to manufacture structures in-situ (such as planetary surface infrastructure) and doing so with significant external leverage, and 7) provide a first step towards evolving additive construction for use on Deep Space Missions.

Why is ACME Game-Changing?

Multiple advancements in technology will be made during the ACME project and are applicable to both NASA and USACE goals.

- A continuous feedstock excavation, size sorting, and delivery system will be designed, fabricated, and tested to allow continuous construction capabilities. This is opposed to the current “batch mixing” of concrete and “assemble one piece at a time” processes in construction. The feedstock will be delivered continuously to a mixing or emplacement implement, which will in turn continuously fabricate a structure.
- A continuous mixing system, where a binder will be mixed with excavated regolith to produce construction materials; this is directly applicable to the concrete emplacement process used by USACE.

- An emplacement nozzle, with shutters to cut off deposition as needed and specifically designed to accommodate planetary regolith feedstock (or other similar terrestrial aggregates), will be designed and fabricated through ACME.
- A focus on construction materials produced from in-situ materials. This work is intended to reduce the mass launched from Earth, and thus cost, for planetary surface missions. It is also directly applicable to terrestrial locations, such as the Islands of Hawaii, where it is extremely expensive to import building materials.

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