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THE MAMBA-CONCEPT FOR AN EXTRATERRESTRIAL HABITAT AND EXPERIMENTAL RESULTS FROM THE LABORATORY MODULE MOCK-UP

Abstract

A lunar habitat must enable astronauts to survive in the harsh lunar environment, but the challenge is not only a technological one: architecture and engineering should be brought together in order to create a livable, rather than survivable home in which a crew can perform optimally. Ideally, the habitat design can be easily adapted for a future use on Mars, after (hopefully) successful testing on the Moon.

In this paper, we present a habitat concept, MaMBA (short for Moon and Mars Base Analog), which combines these three requirements. In its basic configuration, MaMBA consists of six upright cylindrical, hard-shell pressure vessels as main modules and two horizontal cylindrical vessels as airlocks, which are all connected with small inflatable corridor modules. The general design process for MaMBA is progressive, that is, parts of the habitat are designed consecutively, and each part is tested with humans in the loop before the next step is undertaken.

In 2019, a mock-up of the first module of MaMBA has been constructed at the ZARM in Bremen, Germany. The module is an upright cylinder of 4.40 m inner diameter and 6.50 m total height, and houses the habitat's laboratory. The laboratory is equipped with instruments for geological, biological and material sciences analyses.

Two 5-day test runs were conducted: Scientists used the MaMBA laboratory for conducting experiments according to pre-defined protocols. During the experiments, the scientists' motion was tracked with depth perception cameras. Afterwards, the scientists were interviewed and asked to provide feedback and recommendations for improvement. The crew also had access to a conversational user interface, which supported them in their work and provided them with information as needed.

Here, we will highlight some of the results from the test runs. We will focus on lessons learned from the MaMBA mock-up that can be applied to future extraterrestrial habitats, both from an architectural and design standpoint, and we will outline how technology can empower the astronauts working and living in the habitat.