Architecture of Lunar Habitats

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Establishment of a permanently inhabited lunar colony will require suitable habitats capable of hosting a crew of at least 6 people during extended periods of time. A great deal about space habitability has been learned from the experience obtained in orbital platforms, but lunar habitability poses additional constraints. First of all, orbital platforms are shielded from an important amount of solar and cosmic radiation due to their location within the van Allen belts, but no such shielding exists on the surface of the Moon. Therefore, the first requirement a lunar habitat will have to comply with is providing some kind of shielding against cosmic radiation. Also, thermal cycling on the lunar surface is an important environmental constraint for lunar construction materials. Micrometeorite bombardment should also be considered, although most radiation/thermal protection systems would also provide shielding against microimpacts. Regolith, the most abundant and available lunar resource, should be used as a shielding material during the first stages of lunar colonization. The thickness of regolith cover required for radiation protection depends on the duration of crew permanency at the habitat, taking also into account the length of EHA (extra-habitat activity). The first extended lunar missions should last no more than 14 Earth days, in order to avoid lunar night. For this purpose, spacecraft modules could provide the shielding required, perhaps with some additional regolith cover. Such extended stays would permit the development of some infrastructure in situ in order to facilitate, in a second stage, the construction of larger habitats both from materials transported from Earth (e.g. inflatable structures) and in-situ produced (e.g. cast basalt, sintered regolith). In a third stage, lunar habitats should be built completely from in situ resources. In this work, I have considered the constraints imposed by radiation shielding in order to optimize the structural behavior and living conditions of lunar habitats composed of combined inflatable-rigid structures. Minimization of regolith load on the habitat enters in competition with shielding efficiency and tensional stresses due to internal pressurization. A model habitat for a crew of 6 during 6 months is presented.

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